

PACIFIC SEABIRDS



A Publication of the Pacific Seabird Group

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Dedicated to the Study and Conservation of Pacific Seabirds and Their Environment

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Dedicated to the Study and Conservation of Pacific Seabirds and Their Environment

The Pacific Seabird Group (PSG) was formed in 1972 out of a need for better communication among Pacific seabird researchers. The Group coordinates and stimulates the field activities of members involved in research and informs its members and the general public of conservation issues relating to Pacific Ocean seabirds and the marine environment. Group meetings are held annually and the PSG publication, *Pacific Seabirds* (formerly the *PSG Bulletin*), is issued twice a year. Current activities include involvement in seabird sanctuaries, seabird restoration after oil spills, seabird/fisheries interactions, and endangered species. Policy statements are issued on conservation issues of critical importance. Although PSG's primary area of interest is the West Coast of North America and adjacent areas of the Pacific Ocean, it is hoped that seabird enthusiasts in other parts of the world will join and participate in PSG. PSG is a member of the U.S. Section of the International Council for Bird Preservation, the International Union for Conservation of Nature (IUCN), and the American Bird Conservancy. Annual dues for membership are \$20 (individual and family); \$13 (student, undergraduate and graduate); and \$600 (Life Membership, payable in five \$120 installments). Dues are payable to the Treasurer; see Membership/Order Form next to inside back cover for details and application.

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ARTICLES

OCCURRENCE AND BREEDING BEHAVIOR OF LESSER FRIGATEBIRDS (*FREGATA ARIEL*) ON TERN ISLAND, NORTHWESTERN HAWAIIAN ISLANDS

Donald C. Dearborn and Angela D. Anders

Abstract: The Pacific breeding range of Lesser Frigatebirds (*Fregata ariel*) is primarily equatorial. However, a small number of males are regularly seen in a breeding colony of Great Frigatebirds (*F. minor*) on Tern Island, in the Northwestern Hawaiian Islands. In 1998, a female Lesser Frigatebird was present on Tern Island; the ensuing nesting attempt by a pair of Lesser Frigatebirds is the first breeding record for the Hawaiian Islands. In addition, male Lesser Frigatebirds on Tern Island engage in reproductive behaviors directed at female Great Frigatebirds, including courtship displays and extra-pair copulations. The presence of a potential hybrid in this colony suggests that such attempts may sometimes be successful.

Key words: breeding record, extra-pair copulation, *Fregata ariel*, *Fregata minor*, Great Frigatebird, Hawaiian Islands, hybrid, Lesser Frigatebird

In the course of studying sexual selection in a population of Great Frigatebirds (*Fregata minor*) on Tern Island (23° 45' N, 166° 17' W), in the Northwestern Hawaiian Islands (Dearborn in review, Dearborn et al. in review), we made several notable observations of Lesser Frigatebirds (*F. ariel*) well outside of their normal breeding range.

Lesser Frigatebirds breed in the tropical Pacific, Indian, and Atlantic oceans. In the Pacific, breeding has been noted as far north as Washington Island in the Line Islands (04° 40' N) and as far south as New Caledonia (22° 38' S), but most breeding colonies occur between Christmas Island (01° 50' N) and the Fiji Islands (18° 57' S) (Sibley and Clapp 1967, Nelson 1975, Harrison 1983). Lesser Frigatebirds are not known to breed at Johnston Atoll (16° 40' N) or in the Hawaiian Archipelago farther to the north (Sibley and Clapp 1967, Amerson and Shelton 1976; B. Flint, pers. comm.; USFWS, unpubl. data).

The non-breeding distribution of Lesser Frigatebirds is more widespread. In the central Pacific, they disperse from their breeding areas and tend to follow prevailing winds west across the Pacific and then north towards the Philippines and Japan (Sibley and Clapp 1967). Non-breeding individuals have occasionally been seen at Johnston Atoll (Amerson and Shelton 1976) and at Kure Atoll in the Northwestern Hawaiian Islands (Woodward 1972).

OCCURRENCE OF LESSER FRIGATEBIRDS ON TERN ISLAND

Tern Island is located in French Frigate Shoals in the Northwestern Hawaiian Islands (see Amerson 1971 for more details) and is more than 2,000 km from the nearest breeding colony of Lesser Frigatebirds (Fig. 1). Tern Island is 14 ha in size and is a breeding site for 15 species of seabirds totaling over 200,000 individuals (Amerson 1971, Harrison et al. 1984). Roughly 4,000 Great Frigatebirds come to Tern Island to breed (unpubl. data).

Tern Island is part of the Hawaiian Islands National Wildlife Refuge and has been staffed by a small number of USFWS employees and volunteers since 1979. During that time, sightings of vagrant birds have been opportunistically recorded. Lesser Frigatebirds were noted as present on Tern Island during each year from 1983 to 1987, 1989 to 1990, and 1997 to 1999. When notes were recorded in sufficient detail, they generally indicated the presence of a single individual for a limited number of days or weeks. Because of the opportunistic nature of the sightings and their subsequent notation, the absence of a sighting for a particular year does not necessarily mean that no Lesser Frigatebirds visited Tern Island that year. Despite the limitations of this data set, it is clear that Tern Island has been visited frequently by a small number of Lesser Frigatebirds over the past 15 years.

We made observations of Lesser Frigatebirds on Tern Island during our field work with Great Frigatebirds from December 1997 through July 1998 and January to May 1999. Observations in 1998 were made opportunistically, but we never saw more than 2 males and 1 female on the island at any given time. In general, males were noted in the colony relatively often, but females were present only rarely.

In 1999, we counted Lesser Frigatebirds during daily censuses of the entire colony of Great Frigatebirds. From 23 January to 1 May 1999, there were 59 days on which we saw no male Lesser Frigatebirds, 26 days on which we saw 1, 11 days on which we saw 2, and 2 days on which we saw 3. These sightings of males were spread across the pair-formation part of the Great Frigatebird breeding season (Fig. 2). No females were seen during this time period (23 January - 1 May).

Male Lesser Frigatebirds were frequently seen perched in bushes occupied by male Great Frigatebirds. When birds were perched in this manner, we did not observe unusual interactions between males of the two species. However, when a male Lesser attempted to land in such a bush already occupied by male Greats, the perched males would often snap/bite and vocalize towards the landing Lesser. This behavior is sometimes directed towards conspecifics in a similar context, but our impression is that Lesser males are targets of this

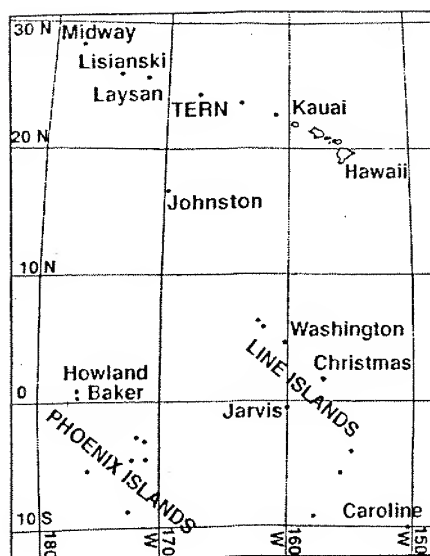


FIGURE 1. Lesser Frigatebirds regularly breed as far north as Christmas Island and Baker Island, near the equator. Our observations of Lesser Frigatebirds on Tern Island comprise the first documented breeding attempts in the Hawaiian Islands.

type of aggression much more often than are Great males.

BREEDING BEHAVIOR OF LESSER FRIGATEBIRDS ON TERN ISLAND

In 1998, we documented the first known nesting attempt by a pair of Lesser Frigatebirds in the Hawaiian Islands. On 22 May, a male Lesser Frigatebird began to occupy and display from a failed nest of a Great Frigatebird on Tern Island. Displaying from failed nests is common among Great Frigatebirds in this colony, perhaps due in part to the limited availability of nest material (unpubl. data). The next day, the Lesser Frigatebird was replaced by a Great Frigatebird. The nest was re-occupied by a male Lesser Frigatebird (unknown if the same individual) 3 days later (26 May). On 27 May, a female Lesser was perched at the nest with the male. On 29 May the male and female Lesser Frigatebirds began alternating occupancy of the nest, and the female laid an egg on 1 June. On 16 June, the male's third incubation shift ended in failure after 7 days. When we checked the nest at 07:50 HST the male was incubating, and when we checked again

at 17:15 there was no adult at the nest, and the egg was cracked and on the ground. The female Lesser was seen at the nest site the following afternoon, approximately 24 hr after nest failure. After nest failure, the egg was intact enough for us to measure; it was 61.4 mm long and 42.3 mm wide, with a mass of 57 g.

As previously mentioned, Lesser Frigatebird females are rarely present on Tern Island. In the absence of Lesser females, Lesser males frequently directed reproductive efforts at female Great Frigatebirds. Courtship behavior in male frigatebirds consists of many behavioral elements, including gular pouch inflation, head tilting, head wagging, wing fluttering, and vocalizations (Nelson 1975), but inflation of the gular pouch is the one component common to all levels of involvement in display behavior (unpubl. data). Of the 54 sightings of Lesser males during the daily counts in 1999, 13 were of males with uninflated gular pouches, 30 were of males with partially inflated pouches, and 11 were of males with fully inflated pouches. Thus, despite the absence of Lesser Frigatebird females on Tern Island in 1999, Lesser males were frequently performing courtship displays.

In at least some instances, Lesser males are successful at courting Great females on Tern Island. In 1998, we witnessed two extra-pair copulations between a mated female Great Frigatebird and an unmated male Lesser Frigatebird. The first incident was not recorded in great detail. In mid-February 1998, a male Lesser copulated briefly with a female Great on a nest and then flew away. The female appeared cooperative during the copulation (female Great Frigatebirds are capable of refusing copulation attempts by males). She remained on the nest and was seen later that day and on many subsequent days with a male Great Frigatebird. She and a male Great shared incubation duties until the nest failed partway through incubation.

The second extra-pair copulation was noted on 13 March 1998. A female Great Frigatebird was seen on a nest in a copulatory posture (head down, tail

raised) with a male Lesser standing on her back. They attempted copulation for approximately 45 sec, but we could not tell if cloacal contact actually occurred. The male Lesser flew away, and within the next minute a male Great arrived with nest material. He landed at the nest and remained perched by the female after giving her the nest stick. The male Lesser reappeared, hovering 1 m above the nest, but was ignored by both the male and female on the nest. He flew away, and the Great Frigatebird pair remained perched on the nest. An egg was laid during the following week. After the chick hatched, blood samples were taken from the chick and from the male and female Great Frigatebird. As part of a study of extra-pair paternity in this population (Dearborn et al. in review), we used multilocus minisatellite DNA fingerprinting to ascertain whether the extra-pair copulation by the male Lesser Frigatebird resulted in fertilization. The genetic analyses revealed that the social father (the Great Frigatebird that helped incubate the egg) was also the chick's genetic father (Dearborn et al. in review).

Although these two interspecific reproductive attempts by Lesser Frigatebird males were not successful, in 1998 we noted a female frigatebird that appeared to be a potential hybrid between Lesser and Great Frigatebirds. This female was brooding a 6-week-old chick and was socially paired with a typical-looking Great male. The potential hybrid female was intermediate between Great and Lesser Frigatebirds in both plumage and body size. Two plumage features that distinguish Lesser females from Great females are a black throat extending in a 'V' onto the breast and a white collar around the nape of the neck (Diamond 1975, Nelson 1975, Harrison 1983). This female had a black throat with a pronounced black 'V' extending onto the breast. This region of black feathers measured 10.3 cm from the tip of the 'V' to the exposed base of the lower mandible. A collar of white feathers encircled the nape of her neck, but it was quite narrow (1.0 to 1.3 cm). Female Great Frigatebirds have a white

ARTICLES – Frigatebirds

breast and a white or grayish-white throat, and they lack a white collar or nape (Diamond 1975, Nelson 1975, Harrison 1983). This female had a pinkish-red eye ring and a light flesh colored bill (traits found both in Lesser and Great Frigatebird populations and therefore not informative about species identity; Nelson 1975).

The exposed culmen length of the potential hybrid female was 104.5 mm, flattened wing chord was 58.7 cm, and mass was 1.32 kg. These values are smaller than those for female Great Frigatebirds at Tern Island [mean culmen = 118.6 mm (range = 112.2 - 123.0), mean wing chord = 61.2 cm (59.4 - 63.2), mean mass = 1.64 kg (1.43 - 1.92); all $n = 20$]. No measurements of Lesser Frigatebirds are available from Tern Island, and detailed comparison to data from other island should be made cautiously because there is substantial intraspecific variation in body size between different Pacific islands, both for Great (Nelson 1975, Schreiber and Schreiber 1988) and Lesser Frigatebirds (Nelson 1975). However, this female is substantially larger than female Lessers from Malaya (culmen range = 88 - 95 mm, wing chord range = 52.6 - 58.0 cm; Nelson 1975), the Coral Sea (mean culmen = 88 mm, mean wing chord = 54.7 cm; Nelson 1975), and Aldabra Atoll [mean culmen = 87mm, mean wing chord = 55.3 cm, mean mass = 0.858 kg (range = 0.760 - 0.955 kg), $n = 45$; Diamond 1975, Nelson 1975]. Thus, the size of the potential hybrid female is larger than female Lessers, smaller than Greats from Tern Island, but within the range of "small-bodied" Greats from Christmas Island and Aldabra (Nelson 1975, Schreiber and Schreiber 1988).

The intermediate nature of the plumage and size of this bird suggests that she may be a hybrid. If so, her

parents may have bred in an area where Lesser and Great Frigatebirds co-occur in large numbers (e.g., Phoenix Islands). Alternatively, her parents may have been a Tern Island Great and a vagrant Lesser, as Great Frigatebirds in French Frigate Shoals exhibit some degree of natal site fidelity (unpubl. data).

In summary, Tern Island is regularly visited by a small number of breeding-condition male Lesser Frigatebirds, despite the large distance between Tern Island and the regular breeding range of this species. Successful reproduction by Lesser Frigatebirds on Tern Island may occasionally occur via either conspecific pairings or hybridization with Great Frigatebirds. It is not clear if the performance of reproductive behaviors by Lesser Frigatebirds on Tern Island is a manifestation of ongoing range expansion, nor is it known to what extent hybrid introgression may impact the population genetic structure of Great Frigatebirds.

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ARTICLES – Frigatebirds

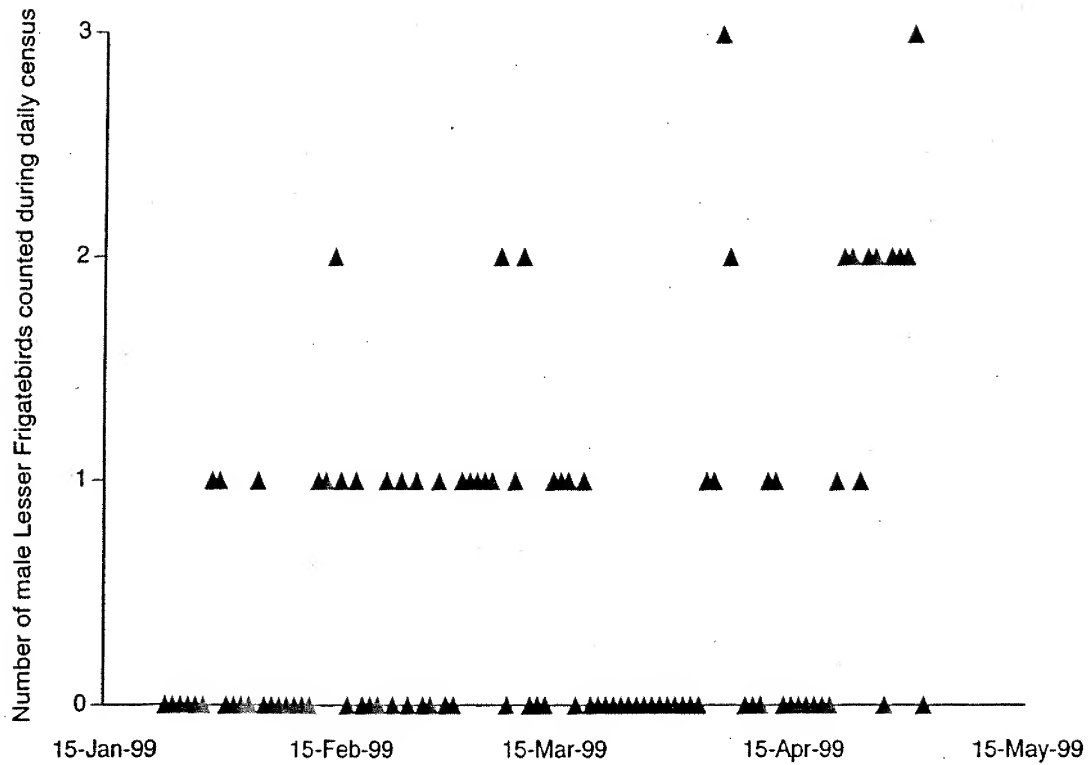


FIGURE 2. A small number of male Lesser Frigatebirds were present in the Tern Island colony of Great Frigatebirds from January to May 1999

NOTES ON SEABIRD CONSERVATION IN THE COOK ISLANDS

Harry R. Carter and Deborah J. Carter

INTRODUCTION

The Tropical Pacific Ocean has long been known for beautiful islands and turquoise waters, but their seabird populations have been largely understudied with a few notable exceptions (e.g., Hawaii). Over the past 200-300 years, most of these islands have been colonies of various European, Asian, and North American countries. Today most of these countries have regained their independence, mainly over the past 20-40 years. The management and protection of seabirds vary considerably between the 26 countries that currently govern the region, and seabird conservation issues are poorly understood in many areas. Flint (1999) and Rauzon (1999) have reviewed and discussed available information on the status and conservation of seabird populations in the Tropical Pacific region, but they provided few details on the seabirds of the Cook Islands. In this paper, we present information on seabirds and their conservation gathered during our brief visit to the Cook Islands in November 1999. On this trip, we landed on and conducted brief surveys at two seabird nesting islands (Takutea on 19-20 November; Maina on 24 November), discussed seabird issues with local residents, and obtained valuable information on seabird populations and issues from Gerald McCormack of the Cook Islands Conservation Service. To provide a better context for information obtained, we also have briefly summarized other available information on the seabirds, geography, and peoples of the Cook Islands.

GEOGRAPHY, HISTORY, AND ECONOMY

The Cook Islands are a small self-governing country in the central South Pacific Ocean located between 8-23°S and 157-166°W (Fig. 1). French Polynesia lies to the east, Samoa, Tonga, and Fiji to the west, and Kiribati and Hawaii to the north. The Cook Islands are comprised of 15 small oceanic islands. Figure 1: 9 islands within

the "Southern Group" and 6 islands within the "Northern Group". The Southern Group includes an array of island types, including 1 mountainous volcanic island (Rarotonga), 4 makatea islands (Mangaia, Atiu, Mitiaro, and Mauke), 1 almost-atoll (Aitutaki), 1 coral cay (Takutea), and 2 low-lying atolls (Palmerston and Manuae). Islands in the Northern Group are primarily low-lying atolls (Penrhyn, Rakahanga, Manihiki, Pukapuka, and Suvarrow), but Nassau is a coral cay. Island types affect the availability of seabird nesting habitats. Atolls usually provide a ring of small low-lying coral reef islands or motus around a lagoon created by the erosion and submergence of the original volcano; coral cays are single low-lying coral islands formed on top of an eroded volcano; the almost-atoll of Aitutaki has a ring of motus around a lagoon with a portion of an eroding volcano (124 m); makatea islands are uplifted coral reef around an eroded volcano (reaching highest elevations of 10-30 m at Atiu, Mauke, and Mitiaro, and 169 m at Mangaia), that are surrounded by new coral reefs without motus; and the young volcano of Rarotonga has extensive upper elevation habitats around various peaks at elevations of 250-650 m, surrounded by a new reef with a few motus. In the Cook Islands, seabirds nest on motus, cays, upper elevation habitats, or trees, primarily using habitats with limited or no access by humans and/or introduced predators.

The Cook Islands have been populated for about two thousand years by Polynesian (Maori) peoples and were some of the last major tropical Pacific islands to become occupied by Europeans (Gilson 1980). Captain James Cook located several of these islands that bear his name in the 1770s. Visits by missionaries began in the 1820s. The islands became a British protectorate in 1888 and were annexed by New Zealand in 1901. During World War II, the United States built airstrips on Penrhyn and Aitutaki. For

more than a century, the United States claimed Penrhyn (or the "Manihiki Islands", including Penrhyn, Rakahanga and Manihiki) as United States territory but eventually relinquished this claim in the early 1980s (Crocombe 1995). In 1965 the islands chose self government, but foreign policy and defense remain in the hands of New Zealand.

At present, less than 20,000 people reside in the Cook Islands (slightly more than prior to European contact; Williams 1837), with about 10,000 on the main island of Rarotonga, especially in the capital city of Avarua. Most people are Polynesian and bilingual (English and Maori); they practice a variety of Christian faiths and the literacy rate is high. Many aspects of traditional Polynesian culture have been retained, especially traditional dancing. Most of the local economy is based on tourism and exports of pearls, coconuts, fruits, vegetables, and handicrafts (Gilson 1980). A small fishing industry serves local communities and tourists; however, the United States and Korea have licenses to fish (longlining) in offshore waters. Tourism and pearl farming industries have developed rapidly during the last two decades: tourism in the Southern Group (mainly Rarotonga and Aitutaki) and pearl farming in the Northern Group (mainly Manihiki and Penrhyn). Other possible future developments include the mining of sea bed minerals (Crocombe 1995). Overall, the islands are little developed to date and 3 islands are currently uninhabited: Suvarrow, Takutea, and Manuae. However, future development pressures for tourism, pearl farming, and marine resources may change this country in many ways.

SEABIRD CONSERVATION ISSUES

Widespread losses of breeding populations of seabirds have occurred in the Tropical Pacific for all but the most predator-resistant species (Flint 1999). Many countries share a documented loss of breeding seabird

ARTICLES – Cook Islands

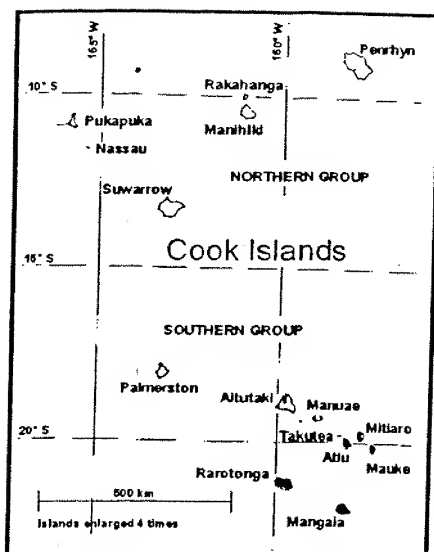


FIGURE 1. Map of the Cook Islands, showing the locations of the Southern and Northern Groups (from McCormack 1994). Darkened areas at Rarotonga, Mangaia, Mauke, Mitiaro, Atiu, and Aitutaki indicate higher elevation areas.

diversity that coincides generally with human colonization and introduced mammalian predators. In Table 1, we list 18 species of breeding seabirds in the Cook Islands (after Holyoak 1980) for each island in order of "predation vulnerability" (modified from Flint 1999). Several vulnerable species are only known from fossils or are currently restricted to a few inaccessible high-altitude sites or ephemeral nesting habitats. While this evidence is consistent with the notion of extensive extirpation of seabirds in the Cook Islands, the original and current distribution of seabirds in the Cook Islands are not well known and some species likely were limited by the availability of suitable nesting habitats. Fossil Polynesian Storm-petrel (*Nesofregatta fuliginosa*) and an unidentified *Pterodroma* petrel were found on Mangaia and fossil Tahiti Petrel (*Pseudobulweria rostrata*) were found at Aitutaki (Steadman 1985, 1991 in Flint 1999). These species may have originally nested at Rarotonga, Mangaia, and Aitutaki where the highest elevation nesting habitats exist (Fig. 1). If so, extirpations would be wider than shown with available fossil evidence. In any case, the "loss" of species known only

from fossil records can be explained with various hypotheses, including the possibilities that these species never bred at fossil locations or disappeared long before Polynesian peoples arrived. On the other hand, Tahiti Petrels may currently nest on Rarotonga and Mangaia without documentation (Pratt et al. 1987). Certainly, the knowledge of secretive, nocturnal species nesting in inaccessible, mountainous areas remains incomplete, despite limited efforts by birding enthusiasts and local biologists (G. McCormack, pers. comm.). Great Crested Terns (*Sterna bergii*) and Black-naped Terns (*S. sumatrana*) were listed as possible breeders at Suvarrow by Holyoak (1980) but subsequent efforts have not confirmed breeding (Pratt et al. 1987; G. McCormack, unpublished data).

Polynesian Rats (*Rattus exulans*) and Polynesian breeds of dogs and pigs were introduced in the last 2000 years by Polynesian peoples and occurred widely in the islands at the time of missionary contact (Williams 1837). Polynesian Rats are small (mouse-sized), omnivorous, and known predators of seabirds and their eggs; many factors affect whether or not they can coexist with nesting seabirds (Atkinson 1985). Black Rats (*R. rattus*) were introduced in the late 1800s to Rarotonga and presently occur on Mangaia and Mitiaro (G. McCormack, pers. comm.); these rats are much larger, omnivorous, well known to impact seabirds, and cannot coexist with accessible nesting seabirds (Atkinson 1985; Rauzon 1999). On 16 November 1999, we toured the Takitumu Conservation Area on Rarotonga and learned from our guide Mataiti Mataiti that nest predation by Black Rats is the main cause of poor reproduction in the endangered Rarotongan Monarch Flycatcher *Pomarea dimidiata*. A rat poisoning program has resulted in a flycatcher population increase and improved nesting success (McCormack and Kunzle 1990a). However, black rats and other introduced mammals (except Polynesian rats) have not yet been introduced to seabird nesting islands. Polynesian Rats apparently coexist with large breeding populations of

larger, predator-resistant seabirds at Takutea, but may have already led to the loss of ground-nesting petrels and terns. At Suvarrow, Polynesian rats occur mainly on Anchorage Island where ground-nesting seabirds currently do not occur (G. McCormack, pers. comm.). It is not clear if the current lack of seabirds on Anchorage Island is due to rats, earlier human occupation, or other factors. Polynesian Rats were abundant on our visit to Takutea but no other mammals have been introduced to Takutea or Suvarrow. Elsewhere in the Cook Islands, cats and European breeds of dogs, pigs, and other domestic animals were introduced widely by the missionaries (Williams 1837).

While introduced mammals have likely impacted predator-vulnerable seabirds at several islands, the greatest documented history of species loss has occurred at Aitutaki and Palmerston, involving the Tahiti Petrel, Red-footed Booby (*Sula sula*), Great and Lesser Frigatebirds (*Fregata minor*, *F. ariel*), Sooty Tern (*Sterna fuscata*), and Black Noddy (*Anous minutus*). Black Rats and dogs were not introduced to these islands, although Polynesian Rats and cats were introduced. Endangered Tahitian Blue Lorikeets *Vini peruviana* are abundant on Aitutaki, probably due in part to the lack of Black Rats. However, these islands have long been inhabited by Polynesian people and higher elevations at Aitutaki and motus at both islands were accessible to Polynesians. Like many other islands in the Tropical Pacific (Flint 1999; Rauzon 1999), extirpations and reduction in breeding seabirds at certain islands in the Cook Islands appear to have resulted primarily from humans and their commensal mammals. Indeed, Polynesian people have long inhabited almost all of the Cook Islands and remaining populations of seabirds likely have become restricted to nesting habitats which are little visited by humans, especially uninhabited islands and remote motus at atolls. Even today, these people still harvest seabirds and their eggs for subsistence. At Palmerston, an annual harvest of about

TABLE 1. Breeding seabirds of the Cook Islands arrayed in order of predation vulnerability (modified from Flint 1999). Information in parentheses reflects additions from this study. Codes: B, breeding; x, fossil record only; ?, breeding suspected; nb, recently no longer breeding; 0, not breeding.

English name	Scientific name	Northern Group ¹										Southern Group ²					
		Su	Pe	Pu	Mh	Rk	Na	Ta	Ro	Mg	Pa	Ai	Mi	Mn	At	Mk	
Polynesian Storm-Petrel	<i>Nesofregetta fuliginosa</i>																
Blue-gray Noddy	<i>Procelsterna cerulea</i>	B								x							
	<i>Pterodroma</i> sp.									?							
Tahiti Petrel	<i>Pterodroma rostrata</i>									x							
Herald Petrel	<i>Pterodroma arminjoniana</i>								0(?)			x					
Sooty Tern	<i>Sterna fuscata</i>	B	B		0(nb)				B		0(nb)						
Black-naped Tern	<i>Sterna sumatrana</i>	B(0)	0(B)		B												
Great Crested Tern ³	<i>Sterna bergii</i>	?(0)															
Red-tailed Tropicbird	<i>Phaethon rubricauda</i>	B	B	B	?	?		B	B	B	B	0(B)	B	B			
Brown Booby	<i>Sula leucogaster</i>	B	B	B				B									
Masked Booby	<i>Sula dactylatra</i>	B	B	B	B	B		B			0(nb)	x					
Red-footed Booby	<i>Sula sula</i>	B		?				B	B	B		B					
White-tailed Tropicbird	<i>Phaethon lepturus</i>		B								0(nb)	x					
Great Frigatebird	<i>Fregata minor</i>		B									x					
Lesser Frigatebird	<i>Fregata ariel</i>	B	B	B	B	B	B	B	B	B	B	B	B	?	?		
Brown Noddy	<i>Anous stolidus</i>	B	B	B	B	B	B	B	B	B	B	x(nb)					
Black Noddy	<i>Anous minutus</i>	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
White Tern	<i>Gygis alba</i>																

¹ Abbreviations: Su, Suvarrow; Pe, Penrhyn; Pu, Pukapuka; Mh, Manahiki; Rk, Rakahanga; Na, Nassau.² Abbreviations: Ta, Takutea; Ro, rarotonga; Mg, Mangaia; Pa, Palmerston; Ai, Aitutaki; Mi, Mitiaro; Mn, Manuae; At, Atiu; Mk, Mauke.³ Breeding suspected at Suvarrow in 1972 but no evidence of nesting was found during 1985 and 1992 surveys (G. McCormack, unpubl. data).

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500-650 juvenile Red-tailed Tropicbirds (*Phaethon rubricauda*) has occurred annually over the past 10-12 years (G. McCormack, pers. comm.). In the past, extensive harvesting also occurred at Takutea for subsistence and red tail feathers were removed from live adults at nests; however, these practices have been banned by the chiefs of Atiu. Egg harvesting of Sooty Terns occurs on Penrhyn but human interference caused colony abandonment at Manihiki about 50-60 years ago (McCormack and Kunzle 1990b). Holyoak (1980) suggested that "collecting and disturbance may have led to desertion of Palmerston by the large colonies of (Red-footed) boobies, Great Frigatebird, and Sooty Tern recorded there two centuries ago". Juvenile Red-footed Boobies (and rarely other seabirds) are harvested under a controlled regime at Pukapuka (G. McCormack, pers. comm.). Indigenous harvesting of seabirds by local Polynesian peoples is controlled primarily by the local communities on each island using traditional methods, such as "ra'ui" (i.e., local-use regulations). The Cook Islands Conservation Act of 1986-1987 attempted to provide a national environment policy, which would have created additional protection for nesting seabirds. However, it was repealed in 1994-1995 when the Rarotonga Environment Act came into effect. No national environment legislation exists at present but the Cook Islands Environment Service is promoting such future legislation (G. McCormack, pers. comm.).

In addition to subsistence harvesting, increasing tourism now looms as a new form of human disturbance affecting seabird populations. To date, tourism has developed mainly at Rarotonga and Aitutaki. At Rarotonga, most seabirds nest in trees or high-elevation habitats, which are less susceptible to human disturbance. However, on Aitutaki, seabirds nest on various motus, some of which are visited on a near-daily basis by tourists in a variety of watercraft. Without identifying our interest in seabirds, we took a tour of the lagoon and several motus on 24 November 1999 aboard a tour boat operated by the Maina Sunset Hotel,

which included landing at Maina Island and One Foot Island. At Maina Island, we carefully surveyed the edge of the coastal vegetation and found only one nest of a Red-tailed Tropicbird (containing a near-fledging chick); no other seabird species were noted. Although our visit was near the end of the breeding season, this island contained much suitable nesting habitat and we suspect that we would have found more seabirds and/or nests at this time of year if a large breeding population was present (see Takutea visit, below). Maina Island is visited daily by tourist boats and unsupervised and uninformed tourists wander over the island for 1-2 hours, although most stay primarily along the beach edge of the island. We also noted a lighthouse tower (apparently been installed during World War II) which may have been visited periodically for many decades. The increasing availability of small motorboats has enhanced visitation of motus at Aitutaki Island in recent decades but the high price of fuel partly limits boat travel not related to tourism. No local-use regulations are in place to protect nesting seabirds at Aitutaki. Except for tree-nesting White Terns and Brown Noddies, few seabirds appear to nest now at Aitutaki. Black Noddies were not found nesting at less-visited Motukitui motu during a survey within the last few years (G. McCormack, pers. comm.).

In several ways, tourism at Maina Island was similar to tourism at Tetiaroa in French Polynesia, which we visited in November 1992. Daily boatloads of tourists also were brought to a small motu and left for 1-2 hours, unsupervised and uninformed about potential impacts to seabirds. We conducted a careful survey of ground-nesting seabirds at a motu at Tetiaroa and noted the following: Brown Noddy *A. stolidus*, ~3,000 nests (eggs/chicks); Sooty Tern, ~150 nests (eggs/chicks); Great Crested Tern, ~125 nests (chicks seen from a distance); and Brown Booby *Sula leucogaster*, 2 nests (chicks). In addition, a few hundred nests of Red-footed Boobies (chicks) and White Terns (chicks) were noted in trees. At the Tetiaroa motu, most tourists chose not to explore heavily-

vegetated areas, but we discouraged one tourist from wandering through the interior of the motu and informed another tourist about the potential impacts of walking through the small Great Crested Tern colony on the edge of the forest and beach. From these brief experiences at Tetiaroa and Aitutaki, we can only speculate that such heavy and uncontrolled tourism over time must be reducing seabird breeding success at such colonies and possibly contribute to past or future extirpations.

SUWARROW AND TAKUTEA

Given extensive human impacts on seabirds, it is not surprising that the vast majority of the remaining populations of breeding seabirds in the Cook Islands occur on two of the three uninhabited islands: Suvarrow in the Northern Group and Takutea in the Southern Group. Manuae also is uninhabited but has little available nesting habitat for many species and was inhabited by Polynesian people until the late 1800s. In the past, Suvarrow was inhabited during the operation of a "mother-of-pearl" industry from 1860-1950 (including World War II observers), and later by the well-known New Zealand hermit Tom Neale from 1952-1977 (McCormack and Kunzle 1990b). In 1978, Suvarrow was designated as a national park, primarily to protect its large and important seabird colonies. These colonies together comprise hundreds of thousands of 9-10 species of seabirds, based on 1985 and 1992 surveys by G. McCormack (unpublished data) of the Cook Islands Conservation Service (Table 2). Seabird colonies are located on several motus around the large lagoon (Fig. 2). A conservation caretaker now lives on Anchorage Island to supervise and inform visitors to the park which have been few to date but include several yachts on trans-Pacific trips and occasional visits by Polynesian people from Nassau and Pukapuka. Plans to re-establish a cultured pearl industry at Suvarrow have been considered for many years. If a pearl industry is re-established or tourism increases, careful regulation of human activities and detailed monitoring of seabird populations will be

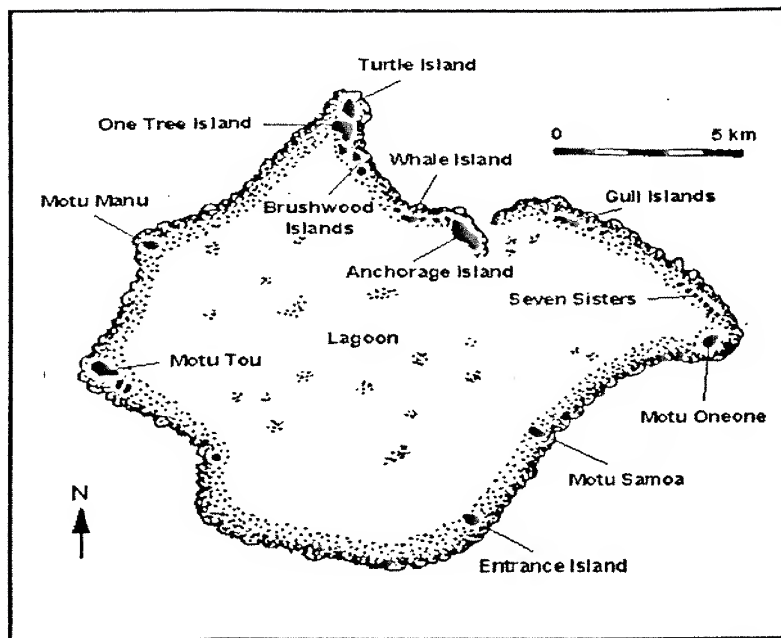


FIGURE 2. Map of Suvarrow, showing motus along the coral reef of this atoll where seabirds nest and the lagoon which may be developed for pearl farming in the future (from McCormack and Kunzle 1990b).

needed to prevent potential destruction of these invaluable seabird colonies.

Takutea has never been inhabited, but has frequently been visited in the past (Kautai et al. 1984; McCormack and Kunzle 1990b; McCormack 1994). In 1903, one chief gave Takutea to the British Crown and it became designated as a wildlife sanctuary. A coconut palm plantation was established between 1905 and 1938. In 1950, Takutea was placed under the trusteeship of all the chiefs to maintain for the people of Atiu. The trustees have banned the killing of seabirds and removal of the red-tail feathers of Red-tailed Tropicbirds, used for the head-dresses of Atiu dancers. Various plans to increase economic return from Takutea were advanced in the 1960s to 1980s, but were unsuccessful. In 1988-1990, the Cook Islands Conservation Service attempted to share management of Takutea with the Ariki and to formally designate it as a national nature reserve, but existing national legislation was found to be inadequate to cement this shared relationship. Added protection of seabird colonies at Takutea is imperative, given the great sig-

nificance of the populations of thousands of 8 species of seabirds, based on 1989-1990 surveys conducted by G. McCormack and Atiu College students (Table 2; see McCormack 1994). In fact, Takutea supports most of the breeding seabirds of the Southern Group.

On 19-20 November 1999, we visited Takutea, which is reasonably accessible from Atiu. We had inquired several months earlier about visiting the sanctuary and Roger Malcolm (Atiu Motel Owner and Mayor) carried our request to the Ariki, obtained their approval, and kindly made travel arrangements. On 19 November, we travelled for two hours (~20 km) by small boat from Atiu to Takutea, under the able boatmanship of commercial fisherman Teina Upoko. A second boat accompanied us for safety and to assist with the landing, with islanders Utumua Kakau, Tou Vainerere, and Tou Tearea. All four were members of the Atiu Fishing Club, a local group dedicated to improving fishing abilities and facilities for the Atiu people. We landed directly on the coral reef

surrounding Takutea, then dragged the boats through the shallow lagoon and over the beach rock onto the sand beach of the cay. Between 11:00-17:00 h on 19 November, we conducted a survey around the periphery of the island to count nesting seabirds. However, we repeated the east side between 06:05-07:15 on 20 November due to heavy rain and 50 km/h winds in the afternoon of the 19th. Due to difficult weather conditions and time constraints, we were only able to conduct a complete nest survey for Brown and Masked Boobies. Counts for all other seabird species were incomplete. Although we did not visit Takutea at the height of the breeding season, we were able to collect some data to help better establish the timing of breeding for several seabirds and occurrence of other wildlife (see Table 3, Fig. 3). In the evening, our hosts provided us with an excellent meal of fresh tuna cooked over a fire and told us fascinating stories about local customs. We slept well on a bed of palm fronds in a dry building that is used sporadically by fishermen and others for temporary shelter.

On our return to Atiu, we were fortunate to be invited to a Polynesian feast hosted by the Atiu Fishing Club. After the blessing of a local minister, seafood of every kind and other delicacies were provided and we had the opportunity to visit with local officials, including Roger Malcolm, Upoko Simpson (member of the Cook Islands parliament for Atiu), Kau Henry (local tour guide), the fishermen that took us to Takutea, and many others. Everyone was interested in protecting Takutea and its seabirds. Many had travelled there periodically to harvest Coconut Crabs (*Birgus latro*), clams (*Tridacna maxima*), and Double-spined Crayfish (*Panulirus penicillatus*), and Green Turtles. In fact, there was much concern about unauthorized harvesting of these foods by non-Atiu people from other islands, which might be contributing to reduced harvests of clams and crayfish. To us, the harvest of non-seabird resources likely is having indirect effects through disturbance to nesting seabirds, as well

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TABLE 2. Numbers of seabirds breeding at Takutea and Suvarrow, Cook Islands, in 1972-1992 (Holyoak 1980; McCormack 1994, unpublished data).

English name	Scientific name	Cook Islands name	Breeding population size (no. of breeding pairs)	
			Takutea	Suvarrow
Red-tailed Tropicbird	<i>Phaethon rubricauda</i>	Tavake	900-2,000	400-500
Masked Booby	<i>Sula dactylatra</i>	Lulu	0-1	3-20
Brown Booby	<i>Sula leucogaster</i>	Kena	18-22	95-500
Red-footed Booby	<i>Sula sula</i>	Toroa	<100	>1,000-1,500
Great Frigatebird	<i>Fregata minor</i>	Kota'a Nui	<500	100-250
Lesser Frigatebird	<i>Fregata ariel</i>	Kota'a Iiti	0	>1,000-8,500
Sooty Tern	<i>Sterna fuscata</i>	Tara	0	80,000-200,000
Brown Noddy	<i>Anous stolidus</i>	Ngoio	<500	250-3,000
Black Noddy	<i>Anous minutus</i>	Rakia	3-26	0
White Tern	<i>Gygis alba</i>	Kakaia	<500	1,000

as direct effects on other natural resources at Takutea. While the Ariki have not allowed regular tourism to develop at Takutea, infrequent trips for educational purposes and film making have occurred. In 1986, many tourists from the cruise ship Society Explorer paid a special visit to Takutea. During some of these trips, nesting seabirds have been disturbed to a limited degree (McCormack 1997, pers. comm.). A series of local-use regulations have been proposed (but not yet implemented) to prevent disturbances to nesting seabirds and maintain a sustainable harvest of other natural resources at Takutea. In 1998, several local-use regulations were established at many coastal areas around Rarotonga by the Ariki to protect and allow recovery of damaged lagoon habitats and natural resources due to harvest and tourism pressures.

FINAL THOUGHTS

This summary of seabird conservation issues in the Cook Islands is preliminary. Additional work is urgently needed to assess the importance of these seabird populations and potential for problems from human subsistence harvesting, disturbance, and introduced predators. We hope that our brief update will stimulate additional

interest and concern in the seabird conservation issues facing this small country and tropical seabirds in general (see Pacific Seabirds 24: 80-81, 1997). It is clear that Suvarrow and Takutea deserve international recognition, added protection, and further study of the size and status of these major seabird colonies. Other seabird colonies

in the Cook Islands also need to be better documented and factors affecting them need further evaluation. In this part of the Tropical Pacific, better management of various human activities (especially subsistence harvesting and disturbance) may be the greatest conservation challenge to undertake. However, other threats to seabirds must

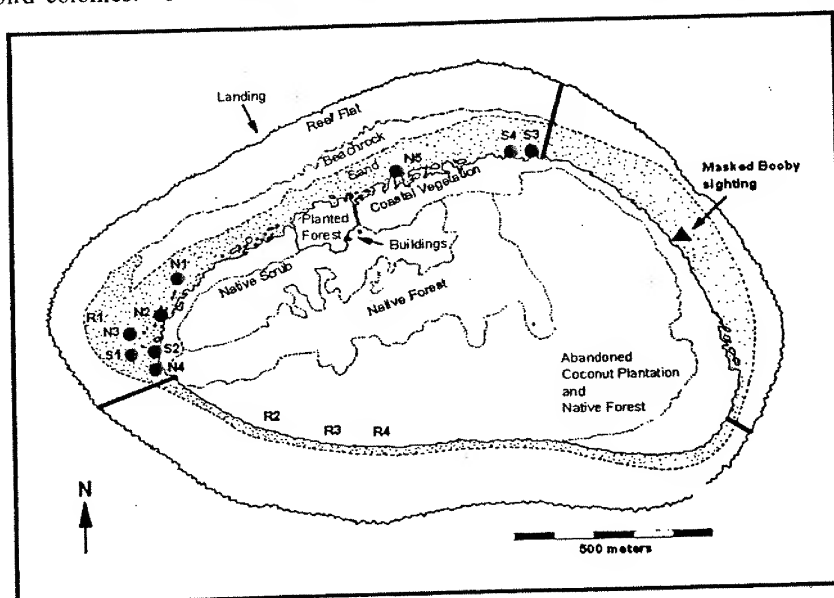


FIGURE 3. Map of Takutea, showing island habitats (from McCormack 1994). Brown Booby (*Sula leucogaster*) nests (N), sites (S), and roosts (R) on 19-20 November 1999 are indicated (see Table 3). Coastal sections of the island mentioned in the text (i.e., south, east, and northwest sides) are defined with dark bars.

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Rats from Suvarrow and Takutea and prevent the introduction of rats, cats, dogs, pigs, and other mammalian predators to seabird nesting islands. However, prior to expending considerable effort and expense to conduct eradications, it is desirable to carefully document: 1) seabird population size, distribution, breeding success, and degree of predation impact by Polynesian Rats; and 2) rat population size, distribution, biology, and diet. Such baseline information will allow a better understanding of the degree of effects by Polynesian Rats on seabirds at these and other islands over time. Actions to protect and manage seabirds also should be considered along with other needs (e.g., economic, self-sufficiency, and cultural) of this small and wonderful country. Well-managed ecotourism for seabirds could help the local economy and help sustain important seabird populations, if associated with an education and conservation program.

ACKNOWLEDGEMENTS

We greatly appreciate the kindness and support of the people of the Cook Islands during our visit, in particular: R. and K. Malcolm, T. Upoko, U. Kakau, T. Vainerere, T. Tearea, the Humphrey family, Atiu Fishing Club, Aitutaki Fishing Club, M. Mataiti, and F. Robati. G. McCormack shared important literature, unpublished data, and stimulating discussions. P.J. Capitolo helped prepare the figures in this paper. F. Gress provided valuable assistance with trip planning. Our travel companion S. Reynolds helped us to experience the seabirds and otherwise enjoy our trip to the Cook Islands. Valuable comments on drafts were provided by: E.N. Flint, J.D.

Gilardi, R. Malcolm, G. McCormack, and V. Mendenhall.

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TABLE 3. Seabirds and other species observed at Takutea on 19-20 November 1999 (see Figure 3).

Species	Observations
Red-tailed Tropicbird (<i>Phaethon rubricauda</i>)	10 juveniles near fledging in nests; 1 fresh dead juvenile (probably succumbed during rain/wind on 19 November); 3 adults flying over vegetation on S side
Masked Booby (<i>Sula dactylatra</i>)	A complete survey was conducted and 2 adults (pair flying low over vegetation on E side) and no nests were noted; 1 other flying off E side
Brown Booby	A complete survey was conducted and 22 adults and 5 nests were noted (see Figure 3): N1, adult (<i>Sula leucogaster</i>) attending one egg; N2, adult attending an empty nest bowl lined with vegetation; N3, adult attending an empty scrape; N4, adult incubating two eggs in nest bowl lined with vegetation; N5, adult attending medium-sized "scapulars" chick); 4 potential nest sites [i.e., attended by an adult but without a nest bowl or scrape (S1-S4)]; and 4 roosts (R1 with 9 adults on beach; R2-R4, single adults in trees); ~25 in feeding flock off NW side
Red-footed Booby (<i>Sula sula</i>)	1 "down" chick in nest; ~25 adults flying over island; ~25 in feeding flock off NW side
Great Frigatebird side (<i>Fregata minor</i>)	~50 adults hovering over island, mostly female; one male in tree; ~15 in feeding flock off NW
Brown Noddy (<i>Anous stolidus</i>)	1 adult on nest; 1 adult carrying a fish flew inland
Black Noddy (<i>Anous minutus</i>)	11 pairs and 5 single adults flying; many collecting nest material from beach; 1 adult with nest material in tree
White Tern (<i>Gygis alba</i>)	28 pairs and 9 single adults flying; 15-20 adults in lagoon feeding flock; 1 adult on egg in bush
Golden Plover (<i>Pluvialis fulva</i>)	2 counted on beach
Tattler sp. (<i>Heteroscelus</i> sp.)	1 counted on beach
Bristle-thighed Curlew (<i>Numenius tahitiensis</i>)	27 counted on beach
Pacific Reef-Heron (<i>Egretta sacra</i>)	2 counted on beach
Green Turtle (<i>Chelonia mydas</i>)	2 fresh nest depressions and tracks at SE corner; 4 older sets of tracks on E side

FORUM

Starting next year, the Pacific Seabird Group will be publishing two journals, *Pacific Seabirds* and *Marine Ornithology*. The editors write about what they mean for PSG.

MARINE ORNITHOLOGY: AN INTERNATIONAL JOURNAL OF SEABIRD SCIENCE AND CONSERVATION (www.marineornithology.org)

Jointly Published by
The Pacific Seabird Group and African Seabird Group

A.J. Gaston¹, J. Cooper¹, and Steven M. Speich²

¹Editors, *Marine Ornithology*

²Business Manager, *Marine Ornithology*

As most PSG members are aware, the PSG Executive Committee decided at the Napa meeting in February to co-publish with the African Seabird Group the existing journal *Marine Ornithology*. This journal has been edited since its inception in 1972 by John Cooper in South Africa. The new *Marine Ornithology* will maintain past traditions of the journal, by providing a truly international outlet for publications relating to marine birds. At the same time it will extend its reach and accessibility by appearing free on the World Wide Web in a form that can be downloaded and printed in the same style as the hard-copy document. The print version will continue to be produced for as long as there is sufficient demand.

The job of editor will now be split into northern and southern hemispheres, with John Cooper continuing to edit papers based on research in the South, while Tony Gaston will be editor for the North. The job of book review editor has been taken on by Lisa Ballance. A distinguished editorial board has been constituted (see below), which we hope will assist us in the task of developing *Marine Ornithology* into the journal of first choice for publishing research on seabirds.

Papers will be posted to the World Wide Web as soon as they have been edited and formatted, and submission in electronic form will be encouraged. Both of these measures should increase the speed with which acceptable manuscripts are published. The electronic

journal will be a facsimile of the printed one, so that page numbering on the electronic version will allow complete citations to be made immediately.

PROSPECTUS SCOPE

Content will be topics relating to the biology and conservation of birds associated with the marine environment: behavior, biogeography, ecology, evolution, genetics, physiology, and systematics. Papers are especially invited on topics relating to the special adaptations of marine birds, the relationship between seabirds and oceanography, and seabird-fisheries interactions. Papers will be accepted on their merits as either pure science (advancement of knowledge), or conservation (advancement of seabird conservation), including issues relating to public policy and legislation. The journal will include provision for research reports, review papers, news items, status reports and opinion pieces. Normal academic publishing policy will be followed with respect to authorship, originality, and sole publication.

RATIONALE

Information storage and retrieval is being funnelled increasingly through the worldwide web and other electronic networks. The advantages of the electronic medium are universal accessibility (for those connected to the Internet), speed of publication, and

cost. By making *Marine Ornithology* freely available in electronic form, we can service researchers and managers in less developed countries and students that do not have access to well-funded libraries.

We intend to provide significantly faster publication than print journals for scientific papers (<6 months). News reports will be faster still. The faster publication that we hope to achieve will improve the value of this journal for exchange of ideas among seabird researchers. We encourage papers that review or comment on current theoretical developments, papers that draw attention to interesting research questions, or papers that contribute to ongoing debates on conservation policy or legislation. Such papers will be subject to peer review, but well-founded speculation will be considered acceptable. We would point to the commentary section in *Oikos* as an example of what we have in mind.

Although *Marine Ornithology* has been around for some years and has received regular submissions from throughout the Southern Hemisphere and Europe, so far relatively few authors from North America it have selected *Marine Ornithology*. We hope that with the new involvement of the PSG, the volume of papers provided by North Americans will increase. Clearly the acceptance of this journal by the scientific community at large will be mainly dependent on the number and quality of papers published.

FORUM – *Marine Ornithology*

If members of PSG would like to see this initiative prosper, we strongly urge you to send us any manuscripts that fit our mandate. To some extent, the fate of the journal is in the hands of the membership. We have set ourselves a three-year period in which to assimilate the change in scope and structure of the journal and to achieve our target of receiving submissions on a par with those offered to top international ornithological journals (*Auk*, *Condor*, *Ibis*, etc.). Please consider *Marine Ornithology* for those manuscripts that may interest an international audience.

CONTENTS

Everything that appears in the printed journal will appear on the web site; we shall have links and additional features in the electronic version.

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Review articles: major papers reviewing an area of marine bird science or conservation that achieve a new synthesis of existing information.

Papers: reports of research results or conservation action exceeding 2,000 words in length.

Notes: short reports <2,000 words.

Status reports: comprehensive reviews of seabird population status for species and geographical regions.

Forum articles: short papers commenting on material carried by the journal, reporting new hypotheses relating to marine bird science or conservation, or reporting biological or physical processes relevant to marine birds but hitherto little known or ignored by marine ornithologists.

Reviews: including web site reviews (drawing attention to web sites of interest to marine ornithologists, a continuing list, added to periodically), equipment test results, software and book reviews.

Conservation and Research News: notes bringing attention to items relating to marine birds or issues in the marine environment that may affect them, as published in rapid-publication journals (*Science*, *New Scientist*); items of international concern for seabird conservation, including legal and policy decisions; brief reports of major oil spills, mass-mortality events,

or other unusual phenomena affecting seabirds.

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Rory Wilson (Germany)
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INSTRUCTIONS TO AUTHORS

Marine Ornithology is published jointly by the African Seabird Group and the Pacific Seabird Group. The journal publishes full-length papers, short communications (usually less than three printed pages long), and book, website and software reviews on all aspects of seabirds and marine ornithology world-wide. Contributions dealing with coastal or inland birds such as gulls, terns, cormorants and pelicans will also be considered. Review papers or Commentaries on important or emerging topics in *Marine Ornithology* are encouraged.

From volume 29 of 2001 onwards, *Marine Ornithology* will be published both in hard copy and in electronic form at www.marineornithology.org. Papers will be posted to the web site individually, as soon as possible after acceptance, so that publication can be speeded. For those browsing the electronic version of the journal, papers will be available in Portable Document Format (PDF) so that they can be captured as exact facsimile of the printed version for reading or printing.

There will be no charge for viewing or downloading papers posted by *Marine Ornithology*.

Authors do not have to be members of the African or Pacific Seabird Groups. All contributions (except for book reviews) are submitted to at least two referees. If revised manuscripts are not returned to the editor within six months of author's receipt of editorial and referee's reports, they will be treated as new submissions. Contributions are normally published in order of acceptance, but electronic submission of original and revised manuscripts will greatly speed the process. We encourage authors to submit in electronic format, as well as in hard copy.

All contributions must be in English, but may use English or American spelling. A summary in another language will be included, if supplied by the author. Full-length papers must include a brief summary; short communications do not require a summary and usually do not include subheads. Contributions are received on the understanding that they contain novel work, conducted by the author, which has not been published, or is not under consideration for publication, elsewhere.

When a work is submitted in hard copy, three printed copies of the manuscript, double-spaced, on one side of good-quality bond paper with wide margins (>2.5 cm) are required. The title page should include telephone and fax numbers, and E-mail address of the corresponding author. The style of layout used in *Marine Ornithology* from Volume 27 (1999) should be followed carefully.

Contributions submitted in electronic form should be accompanied by an e-mail message reproducing the title page and including details of the software version used and the page size. For the present, electronic submissions to the Northern Hemisphere editor should be in MS-Windows format.

Tables must be numbered in the order in which they are to appear. Each table must be on a separate sheet of paper with the table number and title at the top. Figures involving graphs, bar charts or maps should be computer generated where possible and the computer files should be included with

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the manuscript. Postscript or .eps files are preferred. CorelDraw, Quattro-pro and Excel may also be used to generate figures. A good-quality hard copy, black on a white background, must be included. Photographs should be of high contrast, glazed and larger than their final size after reduction.

Captions for figures (which include graphs, maps and photographs) must be supplied on a separate sheet of paper with the figures numbered in the order in which they are to appear. The number of the figure must be written lightly in soft pencil on the back of each figure.

References should be listed at the end of the paper in alphabetical order of the first author's name. Especial care must be taken to ensure that they are written in the style used in *Marine Ornithology*. Journal titles should be abbreviated following standard practice.

English names of species should be capitalized (e.g. White-chinned Petrel) but not the name of a group of species (e.g. petrels). Scientific names of genera and species -- but not family names -- and foreign words should be italicized. Trinomials may be used only when accurately known and essential to the text. Both English and scientific

names must be cited when a species is first mentioned but thereafter only one need be used.

Metric units, decimal points and the 24-hour clock are to be used and dates expressed in the form 31 January 1947.

Accepted manuscripts should, whenever possible, be returned to the Editor on disk (or by e-mail – check with Editor prior to sending) in a PC-compatible format in any standard word-processing package. If the word-processing package is unusual, then an ASCII diskfile of the text should also be submitted. Once again, good-quality unblemished hard copies and digital files of all figures must be supplied.

Page proofs will be sent to the senior author and must be carefully checked and returned within 48 hours of receipt. Reprints are not normally supplied free, but may be purchased if ordered when returning proofs. Arrangements can be made for reprints in special circumstances.

Authors are encouraged to contact the Editors prior to submission of their work for clarification on electronic formats, e-mail submissions, and any other questions they may have.

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All material except book reviews should be submitted to either:

Northern Hemisphere studies

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Reviews, and books, monographs and proceedings for review should be sent to:

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PACIFIC SEABIRDS: WHERE ARE WE GOING NOW?

Vivian Mendenhall
Editor, *Pacific Seabirds*

PSG members have received the *Pacific Seabird Bulletin*, now *Pacific Seabirds*, twice a year since 1974. In the year 2000, the journal finds itself in the midst of change: I have taken over from Steve Speich as editor, and PSG has undertaken joint publication of *Marine Ornithology* with the African Seabird Group (see preceding article). What does this mean for *Pacific Seabirds*?

It is important for us to support *Marine Ornithology*. We will be helping to provide an outlet for peer-reviewed papers of international

interest on marine birds; for the first time, these can appear in one forum. We are devoting funds and people's time to this effort, and it is to be hoped that members will promote the journal by submitting manuscripts.

This raises the question of *Pacific Seabirds*' role. In particular, will PSG's two periodicals overlap? I believe not, because they serve different purposes. *Pacific Seabirds* is, and always has been, primarily an outlet for regional articles and news of the group. PSG surveyed its members during its first year for ideas on projects; 72% of

respondents said that "publish a newsletter" was 1st or 2nd in importance (Pac. Seab. Bull. 1:1, 1974). The new *Bulletin* contained news about PSG meetings and Executive Council decisions, research and conservation in each region, and informal articles. Then as now, its emphasis was on science-based conservation of marine birds in the Pacific.

Four years ago, *Pacific Seabirds* began publishing peer-reviewed articles. In this respect it potentially overlaps with *Marine Ornithology*. However, many articles in *Pacific*

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Seabirds have been notes of regional interest. Of 12 peer-reviewed articles in volumes 23-26, 9 were less than 2,000 words long, and half were concerned primarily with distribution or conservation techniques for Pacific species. Burger (PS 25:58, 1998) pointed out that small regional journals are valuable for publication of advances in the conservation of local populations. Major journals prefer articles of international importance and do not have space for most local concerns. Several prominent societies

publish bulletins as well as journals; usually these include a few peer-reviewed articles. *Pacific Seabirds* will continue to welcome short articles, particularly on regional topics.

Changes that I expect to make in *Pacific Seabirds* are easy to describe: there will not be many. Steve has done a first-class job with the journal. As chair of the Publication Committee, he is continuing to be involved in planning for *Pacific Seabirds*.

I apologize for the late issue. (I never knew there was so much to learn

about desktop publishing! My respect for my predecessors continues to grow.) In the future, *Pacific Seabirds* should appear in early May and November. There will be minor improvements; in particular, I plan to include artwork again soon.

I urge any member with opinions about the journal's content or appearance, or anything else for that matter, to write. (We could even start a Letters column). And please submit manuscripts or art for any section of the journal!

AWARDS

The Pacific Seabird Group presented three awards at the annual meeting on 26 February 2000: the Lifetime Achievement Award to R.G.B. Brown, and Special Achievement Awards to Malcolm Coulter and Steve Speich. Tributes to Brown and Speich appear below; Malcolm Coulter's tribute will appear in the fall *Pacific Seabirds*.

LIFETIME ACHIEVEMENT AWARD

DICK BROWN: AN APPRECIATION

A.J. Gaston

Richard G. B. (Dick) Brown was one of the major names in seabird research throughout the 1970s and 1980s, when he made crucial contributions to our knowledge of birds at sea. His impact can still be seen today. During those decades he made periodic appearances at Pacific Seabird Group meetings. Unfortunately he has been sick for some years and is now permanently hospitalized. However, Dick's contribution to seabird research will be long remembered.

Richard Brown was born in England. He was an undergraduate at Oxford University, and his first scientific publication, "Feeding association between Coot and Little Grebe" (Ashmole, Brown and Tinbergen 1956) came out before he graduated. At Oxford, he was a close friend of Philip Ashmole, which may have had some bearing on Dick's later career with seabirds. Both were involved in ornithological research while still at Oxford, making an expedition to Gavarnie in the Pyrenees in autumn 1955 to study visible migration of birds and insects, inspired by earlier work there by David Lack. This led to a substantial paper on the birds (Ashmole, Brown and Campbell 1957) and also one on insect migration (Brown, Ashmole and Campbell 1958). The latter made the point that the apparent correlation of visible migration of strong-flying insects with headwinds was -- as previously recognized for birds -- probably an artifact, with the insects overflying the



R.G.B. (Dick) Brown in 1989. Photo by Roger Belanger.

AWARDS – R.G.B. Brown

main mountain range with tailwinds but becoming concentrated in the passes with headwinds. In 1956, they went to Scandinavia to observe raptor migration; in 1957, the year he graduated from Oxford, and again in 1959, Dick went to East Finnmark (northern Norway) to study the behavior of birds in continuous daylight (Brown 1963).

Dick went on to become one of a group of very bright graduate students who worked with Niko Tinbergen in Oxford in the 1950s and early sixties. While there, he studied *Drosophila* behavior for his Ph. D., but switched immediately afterwards to his original interest in birds, undertaking post-doctoral research on the behavior of Herring and Lesser Black-backed Gulls at Walney Island, Cheshire. Later, he worked briefly for the Royal Air Force, scaring gulls away from runways.

In 1960, along with two other Britishers (David Hussell and Nick Blurton-Jones), Dick made an expedition to Alaska's Yukon-Kuskokwim Delta to investigate the behavior of Sabine's Gull (a bird that still awaits full research). While in the field, they also collected egg-white proteins for Charles Sibley's famous avian protein taxonomy project, including those of the Spectacled Eider (!). The expedition started with a flight from Britain to Alaska courtesy of the US Air Force, and ended with a return journey by road from Anchorage to Ontario, in Hussell's decrepit Morris Oxford, with a trailer in tow. Memories of Dick's driving on the Alaska Highway still haunt his companions.

In 1965, Dick moved to Dalhousie University, in Halifax, Nova Scotia, to teach psychology, but swiftly shifted to the Canadian Wildlife Service (1967), where he began by working on American Robins as agricultural pests in orchards. During this period he edited the journal *Ontario Bird Banding*, in which illustrious publication he wrote a piece on interference with mating pigeons by other birds. The acknowledgements included thanks to the C.W.S. for their unwitting support to the project – Dick had made most of the observations from his office window while ostensi-

bly "working." He also had this to say in an editorial for the same journal:

I am full of admiration for the masochistic school of bird watchers, but it's not absolutely essential to risk frostbite or pneumonia in order to make a meaningful contribution. Whenever possible, I prefer to do it in comfort, by looking out of windows.

It was at this time that Dick manifested his strong vision of seabirds as appropriate subjects for research. In 1966, Paul Germain (University of Moncton) and Dick initiated PIROP (Programme Intégré de Recherche sur les Oiseaux Pélagiques). This was the first "modern" pelagic seabird survey, based on a systematic technique and a computer database written in COBOL. The surveys were carried out by a corps of observers on a combination of research vessels, ferries, cruise ships and fishing boats, called "vessels of opportunity." Dick himself contributed more at-sea time than anyone. The results were first published in 1975, in the form of distribution atlases for seabirds off Eastern and Arctic Canada (Brown et al. 1975). The work was expanded in 1977 to include waters south to Bermuda (Brown 1977) and updated in 1986 (Brown 1986). These are the best distribution data on seabirds in the northwest Atlantic, and they form the core of a seabird database maintained by the Atlantic Region of the CWS, which is still being added to.

In addition to the descriptive work, Dick also studied the details of oceanographic factors that affected seabird distributions. He was one of the first to recognize the importance of tidally-induced upwellings and other processes that concentrate potential seabird prey. Based at the Bedford Institute of Oceanography, in Dartmouth, Nova Scotia, Dick was ideally situated to take advantage of the many oceanographic cruises conducted by the Institute's research vessels, particularly to the very productive waters of the Bay of Fundy. He also extended his studies to waters off West Africa and around southern South America. His publications on these areas remain some of the best information on their marine birds. For

both scientists and crew of the oceanographic ships, Dick was their first encounter with an ornithologist, and his personal idiosyncrasies and his notable devotion to long hours of observation made a huge impression on them. He is still fondly remembered by a generation of mariners and oceanographers, now mostly retired.

It is worth mentioning that, besides his at-sea studies, Dick also contributed greatly to the local birdwatcher and naturalist scene in Nova Scotia.

Dick's knowledge extended far beyond biology and oceanography. He was an inveterate reader of polar history, being, as he put it "hooked on the drug of the Arctic." He was an excellent writer and put his varied and extensive knowledge to use in popular publications such as the regular column that he contributed for many years to *Nature Canada*, the magazine of the Canadian Nature Federation and occasional pieces for US newspapers. This breadth of interest was probably best expressed in his novel *Voyage of the Iceberg*, a fictional, but close to life, history of the berg that sank the *Titanic*. The book was very well reviewed and, for a Canadian publication from a small press, sold well. It is now out of print, but copies are still available in some bookstores.

Whether or not you saw the recent movie on the same subject, you may be interested in Dick's description of the final minutes of the *Titanic*, as an example of his prose style:

The blaze of lights flickers for a moment, comes on again, then goes out forever. The stern rises faster, and as it comes up, Titanic's fittings begin to break loose. First, the stays snap on the forward funnel, and it comes hurtling down onto the mass of swimmers around the bow. Then, in rumbling crescendo, the three engines, the twenty-nine boilers, the mail and the bullion, the rare wines, the jeweled copy of the Rubaiyat, and more than a thousand screaming people come tumbling and crashing down the length of the ship. Titanic stands for a minute like an enormous pillar, black against the stars. Then, very gently, the biggest moving thing ever made by man slides

AWARDS – R.G.B. Brown

down to the dark ooze two miles below.
(Voyage of the Iceberg: 135)

In addition to being an innovative thinker, Dick was a very original, somewhat whimsical person, of large appearance, a good conversationalist, and excellent company. He was a great colleague, both for his good humor and for his encyclopedic knowledge of seabirds and the marine environment. He always supported younger colleagues. Like the companion of his youth, Philip Ashmole, Dick was a pioneer in integrating marine bird studies with the larger world of biological and physical oceanography. It is there that his contribution was most influential. Sadly, from the early 1990s, he has been progressively afflicted with Alzheimer's disease, reducing his output and more recently preventing him altogether from participating in the science that he loved so much.

The author wishes to acknowledge help from Philip Ashmole, George Divoky, Falk Huettman, David Hussell, and Tony Lock. David Nettleship kindly supplied the photograph.

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SPECIAL ACHIEVEMENT AWARDS

The need to communicate the research findings and conservation news among seabird researchers is critical, especially at a time of great change. The effort to keep up with the flood of information and disseminate it in a timely manner has challenged our volunteer organization. For these collective efforts we acknowledge the contributions of all the past editors and long-time contributors. As well, we honor our future editor; we welcome Vivian Mendenhall and commend her to the task at hand.

What the public sees and knows of Pacific Seabird Group is based on our annual meetings and the publications. However, *Pacific Seabirds* is the publication that reaches the most people and represents us internationally, which is why we choose to honor the unique contributions of two of our editors with the Special Achievement Award.

The recipients of Special Achievement Award at the 27th Annual Meeting of the Pacific Seabird Group are Malcolm Coulter and Steven M. Speich. The tribute to Malcolm will appear in the fall issue.

STEVEN M. SPEICH

Mark J. Rauzon

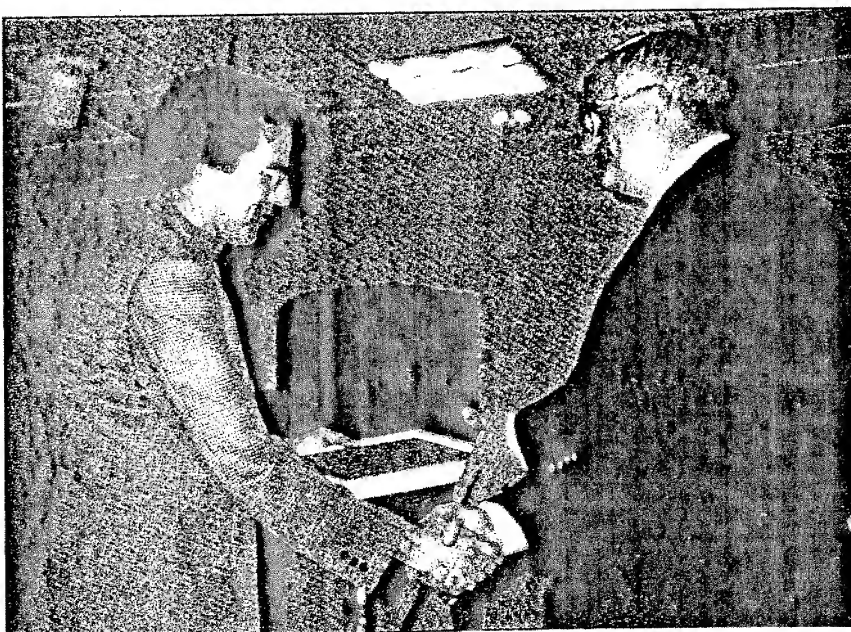
Sometimes I feel that *Pacific Seabirds* is like a storm-petrel chick--sitting alone in a burrow, occasionally provisioned -- say twice a year. I'd like to thank Steve for consistently feeding that chick and teaching it how to fly. There has been nothing short of a technical and communication revolution in the last decade. This award is an acknowledgement of the rapid improvement, the E-evolution, if you will, in our publications that Steve has accomplished on our behalf.

Since he took over the helm of editorship from Martha Springer in 1996, Steve has consistently proposed an ambitious vision of excellence for our "mouthpiece." He proposed that we develop the *Pacific Seabird Bulletin* along the lines of the journal *Science*. No longer content for PSB to be merely a bulletin, Steve changed the publication's name, then modified its format and redesigned the binding. In addition, he introduced peer-reviewed papers, expanded news items, and encouraged op-ed columns. (All these

await your input; the editor is only as good as the material received!) Finally, electronic formatting has helped put PS in the ranks of our peer journals. Now we are joining with the African Seabird Group to cooperatively publish a

second journal, *Marine Ornithology*.

Steve has also developed the web site and linkages to other organizations. Steve has virtually single-handedly taken us across the bridge to the 21st Century and kept us up to speed with



Mark Rauzon presents Special Achievement Award to Steve Speich. Photo by Kim Nelson.

AWARDS – Steve Speich

the rapidly evolving technical revolution. This is indeed a very special achievement, deserving recognition, yet Steve has also contributed in other seabird arenas.

Steve's seabird career and educational experiences informed his role as editor. Steve first visited the Farallon Islands 32 years ago in 1966, where he made a lifelong friend in Ron LeValley. They were both on the Farallon Islands and thought the place would make a great research station one day!

Steve and Ron were students of the late Miklos D. F. Udvardy, recipient of PSG's Lifetime Achievement Award in 1995. Miklos inspired Steve and kindled a passion for historical ornithology, especially the historical ecology of marine birds and native Americans of the Northeast Pacific Ocean. Steve received a BA in Biological Science from California State University, Sacramento, California in 1970, and a Masters of Science in Zoology 1972. Steve did graduate work from 1972 to 1976 in ecology, ecological genetics, population biology, and evolutionary ecology at the University of Arizona and at the University of Washington from 1978 to 1980. He began by studying Cassin's Auklets and went on to study Marbled Murrelets, Mexican Spotted Owls, Cactus Ferruginous Pygmy-Owls and especially swallows. He mapped the pelagic distribution of seabirds in Puget Sound and, with T.R.

Wahl, authored the Washington Seabird Colony Catalog in 1987.

Steve became an environmental consultant in marine and terrestrial ecology. He has worked on a variety of projects, including potential oil spill impacts and sensitivities for Puget Sound. No stranger to controversy, he has served as both expert witness and attorney's consultant to private industry and government. He has worked on timber management plans and a variety of marine projects. Recently he prepared biological assessments of potential impacts for remote-flying vehicles and other military operations on wildlife and habitats in the deserts of Arizona.

Steve was the coordinator of research guidelines for the PSG's Marbled Murrelet Technical Committee from 1987 through 1993, and Editor of *Pacific Seabirds* from 1996 through 2000. He has been Publications Committee Coordinator since 1994 and is continuing in that role. Steve arrived at the beginning of the E-revolution and helped guide and shape our entry into seabird cyberspace, where one squawk is now heard round the world.

Steve Speich has changed the face of PSG more than any other editor has, or will for some time to come. Also, I don't know of any other PSG member who cares as deeply and works so hard for this organization. Through much blood, sweat, and tears, he has

launched PSG into the new millennium, and for this we owe him great thanks.

A BRIEF HISTORY OF *PACIFIC SEABIRDS*

- 1974: *Pacific Seabird Bulletin* began; edited by George Divoky (as PSG secretary-treasurer)
- 1976: Dan Anderson became first appointed editor
- 1978: Jim King became editor; editor made a member of Executive Council
- 1980: Joseph G. Strauch became editor
- 1985: Malcolm Coulter became editor
- 1991: Douglas Siegel-Causey became editor
- 1992: Martha Springer became editor; started publishing on desk-top computer
- 1994: Name changed to *Pacific Seabirds*
- 1996: Steve Speich became editor; format changes, including new cover and printing of photos
- 1997: Peer-reviewed articles first published
- 2000: Vivian Mendenhall became editor

CONSERVATION NEWS

Craig Harrison

LAWSUIT STOPS ARMY CORPS FROM INTERFERING WITH CASPIAN TERN NESTING

The National Audubon Society, American Bird Conservancy, and other conservation organizations filed suit in a Seattle federal court in April to ask the judge to enjoin the Army Corps of Engineers from hazing terns at Rice Island in the Columbia River. During recent years, Rice Island has been the largest Caspian tern colony on earth, and the hazing would have affected the nesting of about 67% of the west coast population. Much of the terns' diet consists of hatchery-raised smolts of coho salmon and steelhead runs, the wild fish of which are listed as "evolutionarily significant units" under the Endangered Species Act. The National Marine Fisheries Service (NMFS) blames the terns for the non-recovery of these runs.

The court agreed with the conservation organizations and ruled that the Corps must first comply with the National Environmental Policy Act and prepare a full environmental impact statement before jeopardizing the tern colony. The Corps immediately filed an emergency appeal of this decision to the 9th Circuit Court of Appeals in San Francisco. The conservation organizations vigorously opposed the government's appeal, and the Endangered Species Recovery Council filed a friend of the court ("amicus") brief in support of the terns. The appellate court refused to lift the stay, and the Corps abandoned its plans for this year.

PSG has been active on this issue since 1998 (Pacific Seabirds 25:69, 26:10, 26:62). Last year, thanks to David Ainley, PSG wrote the FWS Regional Director in Portland and asked the U.S. Fish and Wildlife Service (FWS) to implement a regional plan to restore colonies formerly occupied by Caspian terns in Washington and Oregon. Since 1957, the region has lost

five colonies -- three in Grays Harbor, one in Willapa Bay and a colony of several thousand pairs at Everett Naval Station in northern Puget Sound. Nesting habitat has been lost due to encroachment of human activities or weather on the sandy islands required by the species, or by human development at the Everett Naval Station. Rice Island, an artificial island composed of dredged materials, appeared just in time in 1984. PSG recommended restoring this species to its former nesting sites.

Many scientists with NMFS and FWS questioned any link between tern predation on salmonids and adult returns to the Columbia River system. Indeed, 1999 and 2000 jack returns to the Columbia River are the highest in ten years, suggesting that ocean conditions play a much greater role in salmon survivorship than tern predation. Caspian terns are an easy scapegoat for politicians and natural resource managers for the failure of some "evolutionarily significant units" of salmon to recover. At press time, a substantial portion of the Columbia River Caspian tern population has relocated "voluntarily" 15 miles downstream to East Sand Island, perhaps making some of the controversial management actions by the Corps moot.

FAO PROTOCOLS FOR LONGLINE FISHERIES

Now that the United Nations Food and Agricultural Organization has established protocols that require fishing nations to employ measures to substantially reduce or eliminate bycatch of seabirds in longline fisheries, PSG's efforts have shifted to implementing the protocols in the USA. In early February 2000, PSG expressed disappointment to NMFS that its draft national plan of action is not a model for nations with larger problems and fewer financial resources. We urged that the final plan include the following con-

cepts: (1) adopt a goal of greatly reducing seabird mortality in this nation's longline fisheries; (2) prescribe appropriate mitigation measures for longline fisheries already determined to be a problem for seabirds; (3) specify implementation dates for assessments and mitigation measures; (4) provide for adequate observer coverage; (5) sponsor research to develop improved avoidance measures; (6) include education, training and publicity; and (7) require an annual report. Gerald Winegrad, American Bird Conservancy, organized a meeting with the director of NMFS to discuss improvements to the plan. At the director's request, Winegrad redrafted the plan to include these points. Whether NMFS will adopt these suggestions remains to be seen.

NEWELL'S SHEARWATERS

PSG has been trying for years to persuade FWS to devote more resources to the management of Newell's shearwaters, a threatened species that breeds only in Hawaii. While our successes have been modest, there are some real opportunities for this species to recover if FWS would provide some minimal resources to implement tasks listed in the current recovery plan. In 1999, FWS wrote PSG that there is no recovery team for this species, nor does the Service anticipate forming one. FWS plans on proposing a revised recovery plan that may soon be available for comment, and the Service agrees that surveys of colonies on Hawaii are important if funds can be secured.

FWS GRANT FUNDS TORI LINE INSTALLATION ON ALASKAN VESSELS

FWS has made a grant of \$400,000 to install tori lines (bird scaring devices) on Alaskan longline vessels which are responsible for the deaths of more than 13,000 seabirds

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annually, including Laysan and black-footed albatrosses, northern fulmars and the globally endangered short-tailed albatross. The grant will pay for the installation of davits (cranes extending over the side of the boat) on the larger vessels to support tori poles which hold the bird scaring lines.

Each boat owner must match the FWS funds for the davit installation, while all vessels will be given free tori lines. These flapping lines are towed behind the vessel while the longlines are set, effectively scaring seabirds from diving on the baits and becoming hooked. When correctly deployed and used with properly weighted longlines, tori lines minimize the milling of seabirds. The grant will allow all of the 36 large freezer longliner fishing vessels and about half of the 2,000 smaller longline vessels to install seabird deterrent devices.

PSG members Ed Melvin and Julia Parrish, using funds from the fishing industry, NMFS FWS, and the University of Washington Sea Grant program, have been working together to develop and test various means of reducing the by-catch of seabirds, including the short-tailed albatross. Preliminary results suggest that, with a relatively small investment in seabird deterrent devices, the loss of thousands of seabirds annually can be dramatically reduced. The first year of the study conducted on board longline vessels has been completed. Double/paired tori lines towed over the longlines during line setting, coupled with sufficiently weighted lines, seem to substantially decrease seabird mortality.

PSG CO-SPONSORS IUCN RESOLUTION ON PIRATE FISHING AND SEABIRD MORTALITY FROM LONGLINING IN THE SOUTHERN OCEAN

PSG is now an international member of the IUCN (Pacific Seabirds 25:70). As a member, PSG is co-

sponsoring a resolution with the African Seabird Group and other international organizations to be presented to the IUCN World Conservation Congress in Amman, Jordan, in October 2000. It asks nations and regional fishery organizations to combat pirate fishing for Patagonian toothfish in the Southern Ocean. Among specific recommended actions are sea patrols, removal of economic incentives that lead to the re-flagging of vessels, adoption of stricter port and trade controls, and improving documentation and certification of international trade in toothfish. It also recommends that regional fishery bodies adopt an ecosystem approach that takes full account of the mortality of seabirds by longlining, and adopt regulations and conservation measures that lead to a significant and rapid reduction in such mortality. Finally, it asks all importers, wholesalers and retailers of Patagonian toothfish and its products to purchase and trade only toothfish caught in compliance with verifiable conservation measures.

REPRIEVE FOR BIRDS ON SOMBRERO ISLAND

Plans by Beal Aerospace of Texas to build a \$250 million rocket launching facility on Sombrero -- a windswept 95 acre island in Anguilla -- are on hold. The decision by Beal to call for a halt to an environmental review by British authorities (on behalf of Anguilla) and to reassess its proposal may signal the end of the project to launch telecommunications satellites on the seabird breeding island. An international team of scientists surveyed the island in November 1999. After this survey, Dr. Michael A. Ivie, an entomologist in Montana, said "Sombrero's terrestrial ecosystem is a small, tightly interwoven and very fragile, unique system - a Galapagos in miniature." Jim Stevenson of Britain's Royal Society for the Protection of Birds said "it is now clear that Sombrero is a very special place of global importance." Beal Aerospace is also abandoning its

plans to construct the rockets in St. Croix after litigation blocked the use of a wetland site there. Sombrero is an ideal, nearly predator-free nesting site for seabirds, including brown and masked boobies, sandwich, gull-billed, least, and roseate terns. The island may be dedicated as a nature preserve.

COURT RULES AGENCIES MUST GET PERMITS

The Court of Appeals for the District of Columbia Circuit has ruled that federal agencies are "persons" under the Migratory Bird Treaty Act. The decision requires federal agencies to obtain permits to "take" migratory birds. The case (*Humane Society of the United States v. Dan Glickman*) involved control of Canada Goose populations in Virginia.

Federal agencies had been obtaining MBTA permits for many years (including the U.S. Fish and Wildlife Service, which issues them). However, in 1997, the 11th Circuit Court of Appeals in Atlanta and the 8th Circuit Court of Appeals in St. Louis ruled that the federal government was not covered by the requirement for permits. The Sierra Club had sued to shut down entire national forests to logging because the activity would result in the incidental take of birds. The courts held that logging could continue because the USDA Forest Service was not a "person" and therefore did not need a permit to take birds (see *Pacific Seabirds* 24:49-50, 1997).

The recent ruling is significant because the Circuit Court for the District of Columbia is the most important court in the United States below the Supreme Court. However, their decision is at odds with those by other circuit courts, and because of this "split in the circuits," the issue may be resolved by the Supreme Court.

PSG NEWS

UPCOMING PSG MEETINGS

The Pacific Seabird Group annual meeting for 2001 will take place on February 7-11, in Lihue, Kauai, Hawaii. We will be at the Outrigger Kauai Hotel. There will be more information in the fall *Pacific Seabirds*.

Tentative locations for the next 4 years' meetings are: 2002, Santa Barbara, California; 2003, Vancouver, B.C.; 2004, Cabo San Lucas, Baja California Sur, Mexico; 2005, Newport, Oregon. These plans depend on where the Executive Council finds a local committee, and where the committee finds a suitable site.

ELECTIONS

EXECUTIVE COUNCIL FOR 2000

The following people were elected for 2000.

- Chair-elect: Bill Sydeman
- Secretary: Lora Leschner
- Student Representative: Louise Blight
- Alaska and Russia: Rob Suryan
- Northern California: Kyra Mills
- Pacific Rim: Beth Flint
- Old World: Mark Tasker

All except the Chair-elect serve for two years.

ELECTION PROBLEMS

The election had a very light turnout (24 votes!). This may have been due in part because ballots arrived late; the committee will try to get them out earlier next fall. One write-in candidate won by a single vote. Another person who won the election (for Northern California representative) was unable to accept; the Executive Council appointed Mills in his place.

Once again, many people did not read the ballot instructions and voted for *all* regional representatives. Even some members of the Executive Council may have done this. **Note: each Regional Representative is supposed**

to be voted for *only* by people who reside in that region!!

The Election Committee is investigating whether PSG can carry out elections by Email. This would allow ballots to reach us faster and voting to be more expeditious. We must decide whether Email elections are permitted (PSG must adhere to the provisions of California nonprofit corporation law), and whether electronic ballots would partially replace written ones.

EXECUTIVE COUNCIL CANDIDATES FOR 2001 NEEDED

Nominees so far for 2001 are as follows:

- Chair-elect: Lisa Balance
- Vice-Chair for Conservation: Craig Harrison
- Treasurer: Breck Tyler
- Southern California: Pat Mock
- Oregon and Washington: Roy Lowe
- Canada: Ken Morgan
- Non-Pacific U.S.: Jim Lovvorn

All nominees except Balance are incumbents. **We really need additional nominations, so two or more people can run for every position.** If you would like to run for office, or if you can persuade someone else to, please contact Pat Baird, Election Committee Chair, at (562) 985-1780 or patbaird@sculb.edu.

STUDENT REPRESENTATIVE NOW ON EXECUTIVE COUNCIL

At the 1999 PSG meeting at Blaine, Washington, the Executive Council proposed adding the position of Student Representative, so that issues of concern to student members could be addressed at an executive level. The membership approved the change last summer, via an amendment to the PSG bylaws. Since Louise Blight was the only candidate standing for the position, she attended the Executive Council meetings of February 2000 as an unofficial student representative.

Her position became official upon the meeting's conclusion.

STUDENT ISSUES

Executive Council members at the Napa meeting suggested that future efforts might be better spent on organizing a mentoring program rather than on PSG student awards. Finding volunteers willing to judge student presentations is reportedly a growing challenge, and those who do act as judges often feel that the requirement of choosing a single award recipient does not do justice to the number of high-quality student presentations. A meeting for students to discuss how this mentoring program could best be structured, along with other issues (e.g., student involvement in PSG business; placing student reps on local organizing committees), will be held at the annual meeting in Hawaii.

Travel awards may be given for the Hawaii meeting (see next item).

Student members of the PSG wishing to discuss relevant issues with their representative should contact Louise Blight at lkblight@sfu.ca.

TRAVEL FUNDS AVAILABLE FOR PSG 2001

Financial difficulties often are faced by graduate students wishing to present their work at PSG's annual meetings, and the expenses associated with attending the 2001 meeting (in Kauai, Hawaii) are expected to be greater than usual. In recognition of this, the Executive Council passed a motion at February's Napa meeting releasing a one-time student travel fund of \$US5000. These funds will be available to assist in covering the travel costs of students attending next year's Hawaii meeting. Interested students will be required to apply to the Awards Committee for financial assistance (up to \$500 for 10 students). Details of the application process will be made available in the fall issue of *Pacific*

Seabirds, but some of the criteria will include:

- Matching funds being provided by the student's institution, or
- An indication that other funding options have been pursued
- The student must be senior author on a presented paper or poster
- A statement of need must be submitted by the applicant

Volunteering at the meeting in Hawaii may also be available as a cost-reducing option for students.

THE NEW MARINE ORNITHOLOGY: PSG GOES INTO E-PUBLISHING FROM 2001

As most PSG members are aware, the PSG EXCO decided at the Napa meeting to join with the African Seabird Group to co-publish the existing journal *Marine Ornithology* edited since its inception by John Cooper in

South Africa. The new *Marine Ornithology*, from volume 29 of 2001, will maintain the past traditions of the journal, by providing a truly international outlet for publications relating to marine birds. *Marine Ornithology* is extending its reach and accessibility by appearing free on the World Wide Web (www.marineornithology.org) in a form that can be downloaded and printed in the same style as the hard-copy document. The print version will continue to be produced, for as long as there is sufficient demand. Eventually, all past published articles will be available on the *Marine Ornithology* web site.

The job of editor will now be split into northern and southern hemispheres, with John Cooper (jcooper@botzoo.uct.ac.za) continuing to edit papers based on research in the South, while Tony Gaston (marine.ornithology@ec.gc.ca) will be editor for the North. Lisa Ballance (lisa@caliban.ucsd.edu) has taken on

the job of book review editor. A distinguished editorial board has been constituted for the period 2001-2004, which we hope will assist us in the task of developing *Marine Ornithology* into the journal of first choice for publishing research on seabirds.

Papers will be posted to the *Marine Ornithology* worldwide web site as soon as they have been edited and formatted, and submission in electronic form will be encouraged. Both of these measures should increase the speed with which acceptable manuscripts are published. The electronic journal will be a facsimile of the printed one, so that page numbering on the electronic version will allow complete citations to be made immediately.

See the article by Gaston et al. in the Forum section of this issue for more information on *Marine Ornithology*.

SECRETARY'S REPORT

SUMMARY OF PROPOSED MINUTES OF THE 2000 PACIFIC SEABIRD GROUP EXECUTIVE COUNCIL MEETING

Napa Valley Marriott Hotel, Napa, California, 23 and 25 February 2000

[The full text of the proposed minutes is available from the Secretary, Lora Leschner (leschl@dfw.wa.gov). The minutes will become official when they are approved at the 2001 Executive Council meeting.]

23 FEBRUARY 2000

The meeting was called to order by Chair Ed Murphy at 13:38. Also present were Roy Lowe, Ken Morgan, Craig Strong, Steve Speich, Jim Lovvorn, Julia Parrish, Pat Mock, and Craig Harrison. Murphy held proxies for Beth Flint, Kathy Kuletz, and Rob Suryan; Ken Morgan held a proxy for Alan Burger. Vivian Mendenhall took minutes.

Report from the Chair

A trial joint publication of the journal *Marine Ornithology* by PSG and the African Seabird Group was approved at a special conference call meeting of the Executive Council on 31 January 2000. It was also approved that PSG would spend up to \$2,000 in the first year and up to \$5,000 in each of the succeeding 3 years on the journal.

Treasurer's Report

The report for Fiscal Year 1999 was published in *Pacific Seabirds* for fall 2000 (note that the table columns for 1998 and 1999 were reversed by mistake). PSG has approximately \$55,000 in its operating accounts. There was discussion of how to allocate some of this money to current projects and to investments. The Endowment Fund is fluctuating around a value of \$100,000.

OLD BUSINESS

Awards Committee

The Council voted to give a Lifetime Achievement Award to R.G.B. Brown, and Special Achievement Awards to Malcolm Coulter and Steve

Speich. The awards were made at the banquet. The Council voted to give Hiroshi Hasegawa a Special Achievement Award at the 2001 meeting. Notification of award candidates was discussed. There are no bylaws on awards. The Handbook says that the candidate should be contacted before PSG acts on the award. The awards committee will suggest a procedure at the next Council meeting.

Elections Committee

Results of the 1999 election: Chair-elect Bill Sydeman, secretary Lora Leschner, Alaska representative Rob Suryan, Hawaii/Pacific rep. Beth Flint, Old World rep. Mark Tasker. Kyra Mills was appointed as Northern California representative.

The Council discussed methods to improve voting. Only 25 members voted in the 1999 election. This was partly because ballots were sent with *Pacific Seabirds*, which arrived late; in the future ballots should be mailed separately. Baird said that ballots should be out by 1 October in future election and ballots counted by the end of December. The elections committee will evaluate methods to distribute ballots. The Council approved investigation of e-mail polling as one possibility. Pat Baird, elections committee Chair, will report to the PSG Chair with proposed improvements.

Annual meetings

A report on the 2001 meeting was postponed until 25 February. The 2002 meeting will be in Santa Barbara; the tentative local committee is Harry Carter, Gerry McChesney, Dan Anderson, and Frank Gress. The 2003 meeting will be in Vancouver, B.C.; there is no local committee yet. A tentative site for 2004 is Cabo San Lucas, Baja California Sur, and for 2005 is Newport, Oregon.

PSG Handbook

Kim Nelson has assembled a comprehensive handbook for the PSG Executive Council and meeting organizers.

North American Bird-banding Council

Rob Suryan has been working with the North American Bird-banding Council on a joint handbook. A report will be given to the Council at a later meeting.

Bylaws

The last bylaws booklet was issued in 1994. A new updated booklet needs to be printed. A bylaw change on a sunset law for committees was proposed and discussed.

Sunset law for committees

The Executive Council has the power to create and abolish committees, according to the bylaws (except that the existence of the Conservation and Publication Committees is specified in the bylaws). There was discussion about a process for disbanding committees versus a bylaw change to include a "sunset rule" for committees.

Western Foundation of Vertebrate Zoology

The WFVZ keeps back copies of *Pacific Seabirds* and supplies them on request. They are supposed to receive all journals that PSG receives in exchanges (according to correspondence of about 2 years ago that Jan Hodder has found in files). Speich and Hodder will follow up to make sure that journals received over the past few years are forwarded to WFVZ.

Publications Committee

The Seaduck Symposium has been published; the Canadian Wildlife Service is providing it for free. PSG's role as co-publisher is evident from our

SECRETARY'S REPORT

logo and the preface. The Bycatch Symposium MS will arrive at Alaska Sea Grant next week; it will be published at no cost to PSG. The 25th Anniversary meeting symposium will be published by the University of Hawaii; PSG is being asked to contribute part of the publication costs to keep the price at a reasonable level. The proposed book on Russian work will be produced by CWS alone, since PSG has not contributed to assembling that material. [See also committee report in this issue.]

Vivian Mendenhall was appointed as the new editor of *Pacific Seabirds*. Steve Speich will remain as chair of the Publications Committee and will handle Technical Publications, Symposia, and the PSG web site. Speich will put all *Pacific Seabirds* back issues on CD.

Student paper/poster awards

Some students would like to know the standards by which papers are rated. A copy of the judges' blank rating form will be posted for their information. Louise Blight (Student Representative) said that it also could be included with the Call for Papers. Some students would like to get written comments from judges on their presentations. Lovvorn said that might make judging so hard that no one will agree to do it; he will poll this year's judges on the subject.

Restoration Committee

There was lengthy discussion about its future role. There is no Coordinator for this committee at present. Ken Warheit described its current duties as reviewing Spill Response Plans and writing response. The Council discussed the role of the restoration committee and the possibility that restoration reviews could be prepared by a sub-committee of the Conservation Committee. The restoration guidelines should be condensed for easier use and dissemination.

Xantus' Murrelet Technical Committee

Coordinator Bill Everett reviewed recent activity. The Committee has evolved away from its original mandate. The species warrants a petition for Threatened or Endangered status:

its population is small, it is vulnerable to several acute and chronic threats, and the National Park Service has not responded to PSG's 1993 suggestions for mitigating threats on Santa Barbara Island. The committee recommends that PSG allocate funds to hire a student to do the literature search to support a T&E petition. The Executive Council and/or outside reviewers should review the petition.

The Executive Council authorized the Xantus' Murrelet Technical Committee to prepare a petition to list the Xantus' Murrelet. The Xantus' Murrelet Technical Committee may, if needed, spend up to \$1,500 to prepare a petition to list the Xantus' Murrelet by July 1, 2000. Sydeman said that PRBO has staff available, and \$1,500 would buy 2 weeks of a technician's time. An additional \$1,500 can be spent to complete the petition, at the discretion of the PSG Chair.

Conservation Committee

Harrison said that Caspian Terns on the Columbia River are the biggest issue at present. Perhaps the U.S. Fish and Wildlife Service should acquire the currently unprotected East Sand Island, where birds are being forced by the Corps of Engineers to relocate from Rice Island. Other important issues include bycatch of seabirds on long-lines, and FAO's international guidelines for reducing bycatch.

Seabird Monitoring Committee, Japan Seabird Conservation Committee, Marbled Murrelet Technical Committee

Coordinators were absent and no reports were presented.

Communication between committee coordinators and members

There was discussion of improving communication within committees. Mendenhall said an unnamed committee stopped consulting her as soon as she retired. The coordinator should let members know when issues come up. Thereafter, members should keep in touch with the coordinator to check on progress. Perhaps current committee members and projects could be posted on the PSG web site.

The meeting adjourned at 16:30.

25 FEBRUARY 2000

The meeting was called to order by Chair Murphy at 17:45. Also present were Parrish, Morgan, Lovvorn, Mock, Lowe, Harrison, Speich. Proxies were as on 23 February.

PSG's 2001 Meeting

The 2001 meeting will be 7-11 February at the Outrigger Kauai, Lihue, Kauai, Hawaii. Rooms at this hotel will be about \$110 per night. The Council authorized the local committee to establish a bank account on behalf of PSG.

Travel to this meeting will be expensive, which might exclude many students. PSG has enough in the operating budget to give some matching funds to students. The council approved allocation of \$5,000 for student travel to the 2001 meeting, with these conditions: all candidates submit a statement of need, an abstract, and documentation of other funding (a subsidy or their own money). The awards committee will establish an application process.

Marine Ornithology

The Council authorized expenditure of up to \$3,000 on Marine Ornithology at the discretion of the Chair. It endorsed Tony Gaston's appointment as Northern Hemisphere Scientific Editor. The Council voted to expand *Marine Ornithology's* steering committee to 6, including 3 more from PSG and 1 more from the African Seabird Group.

25th Anniversary Symposium volume

The Council authorized \$5,000 support for publishing the symposium.

Investments

PSG Executive Council should invest some of PSG remaining excess Operating Fund so as to earn good interest on it. (The Endowment Fund earns good interest, but money put there can only be used for publications.) The council authorized the Treasurer to move \$5,000 from the operating fund to a 1-year CD or Money

SECRETARY'S REPORT

Market fund, at the Treasurer's discretion.

Restoration Committee

The Council voted to dissolve the Restoration Committee.

Marbled Murrelet Protocol

This Technical Report has been in preparation for a long time. The committee hopes to get it published before the next field season, so it can be used in training. The Executive Council must approve it before publication, but that would delay it further. The Chair was authorized to approve the Technical Report on the Marbled Murrelet

Protocol on behalf of the Executive Council.

Commendation

The Council voted to commend Ed Murphy for this work as Chair.

The meeting adjourned at 18:48

COMMITTEE REPORTS

The following reports were submitted separately from the Executive Council meeting. The Secretary's Report and PSG News contain results from other committees. Some committee coordinators did not submit reports.

REPORT OF THE JAPAN SEABIRD GROUP

Koji Ono and John Fries

Last summer, great numbers of Rhinoceros Auklets were found dead along the coastline of Hokkaido. In the area of Hokkaido north of Teuri Island, as many as 400 birds per kilometer washed ashore, and eastern Hokkaido also had a steady influx of carcasses along its shores. Dead birds were also found off Sakhalin Island. It is not known whether last summer's higher-than-normal ocean temperatures played a role in this mass mortality event. According to Dr. Yutaka Watanuki's monitoring group from Hokkaido University, Rhinoceros Auklet breeding results in 1999 did not vary greatly from previous years. The Japan Environment Agency intends to establish an investigating committee to study causes and impacts.

At the meeting of the Japan Alcid Society last fall, agreement was achieved on the following resolutions:

- As of fall 2000, the Japan Alcid Society will change its name to the Japan Seabird Group.
- This reorganization into the more comprehensive Japan Seabird Group

will be accompanied by the drafting of a new set of bylaws.

- Literature, data, and other information from many disparate sources will be collected and condensed into a single draft report of a Seabird Colony Catalog by fall 2000.
- Within the Japan Seabird Group, coordinators for each region will be appointed.
- A coordinator for a Seabird Workshop will also be appointed, with the goal of establishing a comprehensive seabird monitoring system in Japan.

The Hokkaido Seabird Center will launch a new web site. The address will be www.seabird.go.jp. Keith Lommel (lommel@rose.ocn.ne.jp), a resident of Japan, will work with the Center to maintain an English version of the site.

If you have any news on Japanese seabirds, please e-mail us: Koji Ono, kojiono@gol.com or ono@seabird.go.jp, or John Fries, fries@uf.a.u-tokyo.ac.jp.

REPORT OF THE PACIFIC SEABIRD GROUP PUBLICATION COMMITTEE

Steven M. Speich, Committee Coordinator

Marine Ornithology

PSG has entered into agreement with the African Seabird Group as partners to publish and produce Marine Ornithology. We are now in the phase of implementing the agreement [see article by Gaston et al. in this issue]. PSG will support implementation with up to \$3000. The steering committee will consist of 6 people, 4 from PSG and 2 from the African Seabird Group.

SYMPOSIUM

The sea duck symposium is now available: *Behaviour and Ecology of Sea Ducks*, R. Ian Goudie, Margaret R. Petersen, and Gregory J. Robertson (Editors). Proceedings of the Pacific Seabird Group Symposium, Victoria, British Columbia, 8-12 November 1995. A special publication compiled by the Canadian Wildlife Service for the Pacific Seabird Group. Published 1999 as Canadian Wildlife Service, Occasional Paper Number 100. Catalog Number CW69-1/100E.

The bycatch symposium is in preparation: *Seabird Bycatch: Trends, Roadblocks and Solutions*. Edward F. Melvin and Julia K. Parrish (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Semi-Ah-Moo, Washington, February 1999. To be published by University

COMMITTEE REPORTS

of Alaska Sea Grant, Fairbanks, Alaska.

The 25th anniversary symposium is in preparation: *Seabirds in a Changing Environment - Advances in Seabird Science*. David C. Duffy (Editor). Proceedings of the Pacific Seabird Group 25th Anniversary Symposium, Monterey, California, January 1998. To be published by the University of Hawaii.

TECHNICAL PUBLICATIONS

No manuscripts have been received for this series. To date, only one Technical Publication has been produced. The Marbled Murrelet protocol is nearing completion.

PACIFIC SEABIRDS BACK ISSUES

Most of the back issues of Pacific Seabirds have been scanned and will be available on CD. There is need for a volunteer to index the back issues so that an interactive database can be included on the CD.

Hard copies of all back issues of Pacific Seabirds are available. These are being housed by the Western Foundation of Vertebrate Zoology. Several issues that were out of print or low in numbers have been reprinted.

PACIFIC SEABIRD GROUP WEB SITE

The PSG web site continues to evolve and expand to serve the needs of PSG. The Seabird Gallery continues to attract contributions. Members

and the Executive Council are invited to take greater advantage of the potential the site offers to communicate with the membership and the world. Articles that have appeared in past issues of Pacific Seabirds are being posted to the PSG web site.

PUBLICATION EXCHANGE PROGRAM

PSG exchange publications are to be housed with the Western Foundation of Vertebrate Zoology. This is part of the PSG agreement with the WFVZ for their housing back issues of Pacific Seabirds and mailing them as requested. PSG members are also able to ask for reprints of articles from journals not generally available.

ABSTRACTS

ABSTRACTS OF PAPERS AND POSTERS PRESENTED AT THE 27th ANNUAL PSG MEETING

The Napa Valley Marriott Hotel, Napa, California, 23-26 February 2000

Abstracts are arranged alphabetically by name of first author. An asterisk indicates person who presented the paper, if not the first author.

A Retrospective Assessment of Primary Productivity in the Bering Sea as Indicated by Stable Isotope Ratios in Seabirds.

Grace E. Abromaitis, Donald M. Schell, and Alan M. Springer. Institute of Marine Science, University of Alaska Fairbanks, abromait@ims.uaf.edu

We used carbon isotope ratios in Thick-billed Murre muscle and feathers to test the hypothesis that a decrease in seasonal primary productivity has occurred in the Bering Sea. Recent studies have shown phytoplankton stable carbon isotope ratios are directly related to cellular growth rates. Following photosynthesis, carbon isotope ratios incorporated into the phytoplankton are conserved as they are passed up the food web to consumers. We analyzed muscle tissue and feathers from Thick-billed Murres for 13 years between 1976-1999. Isotope ratios in newly grown feather carbon indicate diet at that time versus muscle carbon with a longer integration time. Feather samples show variability between rachis and vanes. The carbon isotope ratios ranged between -16.96 and -19.54 ppt and suggest decadal scale changes in primary productivity. From 1976 to the present, mean carbon isotope ratios are significantly lower for 1977, 1985, and 1998 and higher for 1976 and 1992. In contrast, stable nitrogen isotope ratios showed no significant change over the same period, indicating no concurrent shifts in trophic level. Declining carbon isotope ratios without declining nitrogen isotope ratios indicate a change in primary productivity in the Bering Sea ecosystem.

At-sea Distribution of Radio-marked Cassin's Auklets Breeding at Prince Island, California in 1999

Josh Adams, John Y Takekawa, Harry R Carter, Darrell L Whitworth, and Gerard J McChesney. U.S. Geological Survey & Moss Landing Marine Laboratories, Moss Landing, CA jadams@mlml.calstate.edu

In 1999, we initiated a study of the at-sea distribution of radio-marked Cassin's Auklets in southern California. Thirty-five auklets were captured at nest sites on Prince Island. We determined sex of marked birds by chromosomal analyses of blood. Most radio positions (89%; N=377) occurred at sea; incubating birds were located on Prince Island. The number of locations per individual averaged $11.6 \text{ km} \pm 1.6 \text{ SE}$ (range=0-27 km). Auklet locations were concentrated north of the colony ($14 \text{ km} \pm 0.5 \text{ SE}$; range=1-76 km) and did not differ by sex. Auklets counted on low-elevation aerial seabird surveys conducted throughout the Southern California Bight in May 1999 closely matched the distribution of radio-marked auklets. Spatially consistent at-sea distribution of auklets between March and July 1999 coupled with early and protracted breeding and multiple breeding attempts by individual birds probably indicated abundant and persistent prey available near Prince Island. Prey conditions were influenced by early upwelling conditions off Point Conception in late 1998. Strong upwelling and cold water conditions persisted through June 1999.

Olfactory Sensitivity of Foraging Procellariid Seabirds in Unimak Pass, Alaska

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Procellariiform seabirds are known for their sense of smell, yet few behavioral experiments have addressed whether tube-nosed birds use olfactory cues to forage at sea. We describe results from controlled, shipboard experiments performed in Unimak Pass, Alaska. Two buoys were placed 100 m from the ship; one was scented with an odor, while the other was unscented. We used three odors: cod liver oil, pyrazine, and DMS. We recorded numbers of seabirds that approached within a 10-m radius of either buoy for 30 min. We observed Sooty and Short-tailed Shearwater, Northern Fulmar, Glaucous-winged Gull, and Tufted Puffin within 10 m of either buoy. Shearwater spp. approached all three of the scented buoys significantly more often than the unscented control buoys. Northern Fulmar approached the buoys scented with cod liver oil and pyrazine significantly more. Glaucous-winged Gull and Tufted Puffin approached the scented buoys as often as the unscented buoys for cod liver oil and DMS. Pyrazine was the only odor approached significantly by all species. These results support previous findings that some species of Procellariiformes use olfactory cues to forage.

The Effects of Age, Environmental Conditions, and Mass on the Stress Response of Leach's Storm-Petrels

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We studied the adrenocortical response to stress in Leach's Storm-Petrels on Kent Island, New Brunswick, Canada during the summers of 1996, 1998, and 1999. Age, environmental conditions, and body mass were investigated as explanations for variation in the stress response among individuals. The oldest age class (26-35 years) had significantly lower corticosterone levels at 15 min and 30 min after capture than younger age classes. A significant year effect resulted from analysis of the data. The years had very different weather conditions. Individuals sampled during one of the foggiest summers on record (1996) had both higher baseline corticosterone levels and lower responses to stress than individuals sampled during two of the warmest summers on record (1998 & 1999). Mass was also different from year to year, with 1996 > 1998 > 1999. Mass was negatively correlated with maximum corticosterone levels. Higher body mass may allow individuals to modulate their response to stress.

Impact of an El Niño Event on Marbled Murrelet Diet and Fecundity in Central California

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El Niño events typically reduce the availability of zooplankton to coastal marine predators in the California Current system. This variation in food availability appears to impact the fecundity rates of several species of seabirds. We investigated these short-term climatic impacts on the food sources of an endangered coastal seabird, the Marbled Murrelet. We used stable isotope analysis of nitrogen and carbon isotopes in prey tissues and murrelet feathers to infer variability in primary food sources (zooplankton and fishes) between El Niño and non-El Niño years. Murrelet diets appeared to include more zooplankton during the pre-breeding stage of non-El Niño years,

which were associated with higher murrelet fecundity. During El-Niño years, zooplankton were less represented in the bird's pre-breeding diet, and fecundity was significantly lower.

Beyond the Shelf Break: Overlap of Zooplankton Distributions and Foraging Locations of Breeding Cassin's Auklet from Triangle Island, BC.

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To investigate the causal basis for patterns of seabird feeding distributions we couple fisheries oceanography, radio telemetry and colony based research. We examined the marine distributions of breeding Cassin's Auklet from their largest colony on Triangle Island, BC using aerial telemetry in 1999. Concurrently, zooplankton was sampled at 16 stations along a cross shelf transect in the vicinity of the seabird colony. The majority of the birds were concentrated SW of the colony 40-75 km offshore, parallel to, but well off (35-50 km) the shelf break in deep water (1500m-2000m). During May, large bodied copepods dominated the nestling diet. Zooplankton samples collected in May indicated that large bodied copepods were located primarily beyond the shelf break demonstrating overlap with the radio-tagged parent seabirds. Satellite images suggest that the zooplankton rich waters off the shelf break were physically displaced by the extensive freshwater runoff from unusually heavy snowfalls the previous winter. We plan to repeat the study in 2000 to examine interannual variability in the distribution of zooplankton prey and the seabird foraging locations.

An Experimental Test of Egg Neglect Patterns in Rhinoceros Auklets

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Many birds interrupt incubation in order to spend time away from the nest.

For Passeriformes, these excursions usually last only minutes. For seabirds, egg neglect may last a day or more, allowing parents to increase foraging time. Egg neglect in alcids is reportedly most common early in incubation, corresponding with slower embryonic growth. To test whether developmental constraints of older embryos have selected against neglect late in incubation, we experimentally chilled two separate groups of Rhinoceros Auklet eggs. Eggs were chilled to ambient temperature for 48 hours at 7 or 30 days of age, and survivorship for the two groups recorded. We also examined the effect of experimental neglect on hatchling size and incubation period length. Data for newly-hatched experimental chicks were compared with those of controls. We found no difference in morphometrics or hatchability among chicks from experimental and control eggs. However, experimentally chilled eggs hatched an average of two days later than controls. Our results suggest that for some seabird embryos, survival is not affected by age at neglect; parent birds may neglect at any stage of incubation. Decreased neglect as incubation progresses may instead be explained by increased parental investment in the embryo over time.

At-Sea Foraging Distributions of Cassin's Auklets Breeding at Triangle Island, BC

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We conducted a radio-telemetry study to determine the at-sea foraging distributions of Cassin's Auklets breeding at Triangle Island, British Columbia. Our goal was to evaluate the utility of proposed boundaries for a Marine Protected Area (MPA) around the Scott Island group, a region recently identified as an Important Bird Area (IBA). During the chick-rearing period in June 1999, 39 adults were captured and fitted with small transmitters. We conducted aerial surveys

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over the open ocean to locate these marked individuals during two survey periods, 9-10 and 23-24 June. During these periods, most marked birds were detected in a relatively small area 40-75 km southwest of Triangle Island in waters >1000 m deep and well outside the proposed MPA boundary. This distribution pattern was consistent across the two survey periods and especially across days during the second period. Similar telemetry work is being proposed for June 2000 to verify if this pattern holds across years.

Evidence of Renesting in the Marbled Murrelet: Inferences From Radio Telemetry

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Renesting, a second breeding attempt after an early season failure, is common in some seabird species but never observed in others. Renesting has never been previously documented in Marbled Murrelets. Standardized, daily helicopter telemetry was used to determine breeding chronology and habitat use of individual Marbled Murrelets in Desolation Sound, British Columbia during the 1999 breeding season. Data from a male bird, whose mate was not radio marked, suggest strong evidence of renesting. It appears that initial egg laying occurred on ~8 May with nest failure after ~8 days. The nest site was located by helicopter prior to failure. 14 days after assumed nest failure, activity patterns show initiation of a second incubation cycle. The new nest site was located in the same forest patch as the original nest location. This site was inaccessible from the ground so it was impossible to determine whether both breeding events used the same platform or tree. Telemetry inferences suggest that a ~30 day incubation period occurred during the second breeding attempt. While fledging success is unknown, ground based telemetry at dusk and dawn near the nest patch and along the

bird's suspected flyway suggest the nest was active late in chick rearing.

Low Productivity: The Main Cause of a Population Decline in Red-legged Kittiwakes at St. George Island, Alaska

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More than 70% of the world's Red-legged Kittiwakes breed at St. George Island, Pribilof Islands, Alaska. Periodic counts of birds on index plots indicate the population has declined between 1976 and 1999. Productivity (chicks fledged per nest site) has been estimated annually during this 24-year period, and a simple population model was constructed to evaluate whether the observed population decline could have been caused primarily from inadequate recruitment due to low reproductive success. Model parameters included the average adult survival rate (estimated from a study at Buldir Island), and the average juvenile survival rate from fledging to age 1 (this parameter was varied in the model throughout a range obtained for Black-legged Kittiwakes in the North Pacific Region). The initial age distribution was set arbitrarily, but after the initial run, the average age composition of the four most recent years was used to initiate additional runs. Population curves generated from model simulations were similar to the curve generated from observations on plots. This outcome suggests that inadequate productivity, instead of excessive adult mortality, was the major reason for population declines.

Seabird Conservation in the Cook Islands

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In November 1999, we visited two seabird nesting islands in the southern Cook Islands in the South Pacific

Ocean and discussed seabird conservation issues with local residents and government biologists. Eight seabird species breed at Takutea Island (including 2,000 pairs of Red-tailed Tropicbird) which has been protected as a wildlife sanctuary since 1950 by the Polynesian chiefs of Atiu Island. Small numbers of seabirds breed at Maina Island (and other islands within the Aitutaki Island lagoon) which has been visited frequently for several decades. Nine seabird species (including 200,000 and 8,500 pairs of Sooty Tern and Lesser Frigatebird, respectively) breed at Suvarrow Island, a national park since 1978 in the northern Cook Islands. Seabird conservation in the Cook Islands has been largely conducted through traditional methods of protection of natural resources and use of seabirds for food by local Polynesian peoples, but management of several colonies may be shared with the national government in the future. Baseline numbers of nesting seabirds at Takutea and Suvarrow were documented in 1985-1992 but other colonies are not well described. Additional efforts are needed to document, monitor, and protect seabird colonies in the Cook Islands, given increasing impacts at seabird colonies from tourism, harvesting, and other factors.

The Relationship of Reproductive Success of Black-Tailed Gull Breeding on Teuri Island and Habitat Structure

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Black-tailed Gulls, *Larus crassirostris*, breed in the coastal region around the Japanese archipelago. Teuri Island (44°25'N, 141°19'E), northern Japan, has one of largest colonies of this species. In 1987, about 30,000 pairs bred mainly on the southwestern part of the island. In 1994, the number had decreased to 14,000 pairs and about 30% of them had moved to the middle of western edge. Moreover, the reproductive success of the gull is low

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for this period. At present, the dominant plant species on Teuri Island is a 70-100cm tall grass which has spread in area since the previous survey. Black-tailed Gulls seem to avoid breeding in the taller grass habitat. To research the relationship between reproductive success of the gull and habitat structure, we compared the reproductive success in tall habitat and in short habitat in 1998 and 1999. In both years, gulls nesting in shorter grass habitat had higher reproductive success as compared to conspecifics nesting in tall grass. During the fledging period, both chicks and parents were covered by tall grasses. This affected reproductive success and gulls avoided nesting in the tall grass habitat.

Demography of the Desolation Sound Marbled Murrelet Population

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A population of between 3000-5000 Marbled Murrelets, *Brachyramphus marmoratus*, has been studied at Desolation Sound in the Strait of Georgia, BC, since 1991. Using Capture/Mark/Recapture CMR approaches we have estimated survival and recruitment rates of this population. In addition, the use of radio telemetry has allowed us to monitor nest success of 57 active nests during the summers of 1998 and 1999. From these nests we can also calculate nesting success and fecundity of the population. Using these data we provide the latest estimates of population growth rate for this species.

The World's Largest Caspian Tern Colony: A Review of Dynamics in the Pacific Coast Population

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Nesting distribution, survivorship, and mechanisms of population expansion in the Pacific Coast Caspian Tern were examined through a review of colonial breeding records and the analysis of 145 band recoveries of birds banded as juveniles between 1975-1999. Dramatic redistribution and growth have occurred in the population since it was last comprehensively reviewed in 1981. The Pacific population has doubled since 1981, apparently all by intrinsic growth. Although some colonies have vanished (e.g. coastal Washington), there are currently more breeding locations than there were 20 years ago. Growth at individual colonies, especially those in the Columbia River estuary, likely has resulted from extensive recruitment of birds from the other colonies in the Pacific coast region. This study reconfirms the previously documented low philopatry of this population. The Columbia River estuary colonies (Rice Island and E. Sand Island) account for 70-75% of current Pacific Coast population (13,000 pairs). The Rice Island colony of 8000+ pairs is probably the largest colony ever recorded in the world. Factors promoting the concentration of breeding terns in the Columbia River estuary are discussed.

Timing of Fledging in Pigeon Guillemots

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Nocturnal fledging in seabirds has apparently evolved to reduce the risk of predation at seagoing. For species lacking post-fledging parental care, such as Pigeon Guillemots, seagoing is the beginning of an independent existence and could be expected to be sensitive to a variety of selective pressures. We examined the fledging of 60 Pigeon Guillemot chicks raised at the Alaska SeaLife Center as part of a study of restoration of populations following the Exxon Valdez Oil Spill. Chicks older than 29 days had their nest boxes moved to a platform where

they could both leave their box and fledge. The daily feeding regimen was unchanged. Activities of chicks were recorded on videotape from sunset to sunrise. The majority of fledging occurred late in the twilight period just before darkness was complete. Fledging in a relatively restricted period in late twilight, rather than throughout the period of darkness, could have evolved for a number of reasons. Twilight fledging might assist the fledgling's visual orientation during seagoing while maximizing the time between fledging and sunrise. The latter would allow departure from the nesting area while predation risks are low and maximize the period of acclimatization to the marine environment before initiating foraging at sunrise.

Corticosterone Levels of Gulls at Two Sites Suggest Differences in Habitat Quality

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Long-lived seabirds face tradeoffs between reproduction and survival. As breeding conditions worsen, concentrations of the stress hormone -- corticosterone -- rise, directly decreasing parental investment. Thus, corticosterone levels are an indicator of cumulative stress and parental investment. In this study, we measured body condition, egg loss, predator visitation, and corticosterone levels of Western/Glaucous-winged Gulls nesting in Grays Harbor, Washington (GH) and the Columbia River estuary (CRE). Gulls nest in two habitats within each colony: sand and vegetation. All measures were worse at GH relative to CRE, but did not appear markedly different between habitat types. The exception was egg loss, which was greater only in GH sand versus vegetation habitat. In short, GH is an inferior breeding location for gulls. In the CRE, efforts are underway to reduce Caspian Tern consumption of salmon smolts by relocating the world's largest Caspian Tern colony from CRE to GH. Our findings

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suggest that breeding conditions are inferior in GH relative to CRE. Thus, tern reproductive success, and possibly site fidelity, may also be poor in GH.

South San Diego Bay Salt Works Acquisition and Planned Restoration for Fish and Wildlife

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The U.S. Fish and Wildlife Service, employing a team from Refuges, Coastal, and Endangered Species programs, has accomplished the acquisition of 800 acres of the Western Salt Works in South San Diego Bay. This acquisition of private property, currently operated as salt evaporation ponds, will allow valuable improvement in fish and wildlife habitats, particularly for nesting seabirds, endangered California Least Tern, and threatened Western Snowy Plover. Existing biological diversity and colonial nesting seabird nesting activity is protected by management of these lands as a National Wildlife Refuge. Salt making may be modified or eventually cease and biologically "dead" areas may be restored to high habitat value wetlands. With the expected termination of commercial salt production, restoration of hundreds of acres of tidally influenced wetlands, mudflats, and salt marsh may be accomplished after a restoration plan has been completed. A wide variety of migratory shorebirds and seabirds would benefit by restoration of tidal flats and seasonal ponds, and secure, high tide loafing and foraging areas. An additional 600 acres of State-owned salt works lands may also be converted out of solar salt making into fish and wildlife habitats. This 1400-acre site has become part of a new National Wildlife Refuge and been designated as a regionally significant part of the Western Hemisphere Shorebird Reserve. This acquisition will help reverse the southern California trend of coastal wetland loss and degradation by removing an industrial use, replacing it with a Na-

tional Wildlife Refuge and high value fish and wildlife habitats.

Two Special Seabirds, the Nazca Booby and Madeiran Storm Petrel, and a Tribute to Luis Monteiro

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We have found evidence that two species of tropical seabirds each represent two reproductively isolated populations. Masked Boobies in the eastern Pacific occur in two distinct forms: boobies breeding in the Galapagos Islands and Malpelo have orange bills, whereas those at most other colonies have yellow bills. These two types also differ in morphometrics, vocalizations, and feeding habits, and mate disassortatively at Clipperton Island (Pitman and Jehl 1998). We found that cytochrome b sequences of orange- and yellow-billed types are distinct, and that the orange-billed forms may be more closely related to boobies from the Caribbean. Band-rumped Storm Petrels, *Oceanodroma castro*, in the Azores breed in two temporally segregated populations: hot- and cool season breeders. Morphology and vocalizations of these populations are distinct, and Monteiro and Furness (1998) suggested that the hot-season population may have arisen from the cool season population through sympatric speciation. We have found that cool and hot season populations are genetically distinct. Whether the origin of the hot-season population represents a case of sympatric speciation remains to be determined.

Nestling Diets of Rhinoceros Auklets and Tufted Puffins at Three Colonies in Alaska

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Opportunistic sampling by the authors includes 20 colony-years of data on the nestling diets of Rhinoceros Auklets in three widely separated colonies in Alaska. In some colonies and years we obtained comparative information on Tufted Puffins' diets. The principal prey of Rhinoceros Auklets (>25% by weight in one or more locations and years) included sand lance, capelin, greenling, sablefish, and salmon. Principal prey of Tufted Puffins were sand lance, pollock, prowfish, sablefish, and herring. Though sand lance are keystone prey of both species in the Gulf of Alaska, Rhinoceros Auklets took larger and older individuals on average than Tufted Puffins sampled concurrently. During four consecutive years in the 1990s, sand lance availability near Middleton Island, north-central Gulf of Alaska, dropped to low levels, as indicated by the diets of both puffin species. Other temporal changes in the Gulf since 1978 include increasing use of pollock and sablefish. Juvenile salmon comprised more than 50% of the nestling diet of Rhinoceros Auklets at Middleton in one year. Puffins are prime candidates for long-term ecological monitoring in the Gulf because of information they can furnish on vital forage species and early life stages of several species of commercial importance.

Parental Provisioning Behavior of Tufted Puffins, *Fratercula cirrhata*, During a Successful Reproductive Year

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Life history theory states that the level of parental investment is a result of a trade-off between present and future reproduction. The theory predicts that investment decisions are based on the value of the current brood relative to the value of the parent's own future reproduction. To examine the relationship between parental investment and nestling age and size in 1999, I measured nestling growth rates and parental

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provisioning rates of Tufted Puffins breeding on Triangle Island, British Columbia. In contrast to the total reproductive failures experienced between 1994 and 1998, fledging success for 1999 was estimated at 88%. Provisioning rates increased with nestling age and declined late in the nestling period. Provisioning rates for the first 10 days of nestling growth did not explain the variation in chick mass at day 10, suggesting variation in the quality and/or quantity of prey species fed to the nestlings. Parents feeding with low quality bill loads had higher provisioning rates, longer chick-rearing periods, and fledged nestlings with lower peak and fledging masses. Given the potential costs associated with provisioning, parental investment decisions may change during years when food is less available.

What a Drag: Behavioral Effects of Radio-Marking Common Murres

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Radio-telemetry is an increasingly popular method for assessing animal habits. However, the success of telemetry studies depends on the reaction of the animal to the tag, including attachment method. In this pilot study, we compare the effectiveness of two attachment methods of radio-transmitter attachments on Common Murres, *Uria aalge*, nesting on Tatoosh Island, Washington. In 1997, we fixed 8 transmitters with epoxy glue to the back feathers of murres. In 1999, we used subcutaneous anchor transmitters on 5 murres. All birds were monitored from blinds fitted with one-way mirrored windows offering close, clear views. Behavioral effects of tagging were monitored by comparing marked birds to non-marked controls. In half-hour intervals we recorded dominant behavior every five minutes, as well as all instances of chick feeding and fighting. Pair switching, fish type, and fish size were also recorded. An automated receiver recorded proportion of

time on and off the colony for all tagged birds. Retention time was significantly shorter for glue tags than subcutaneous anchor tags. Transmitters alter the on and off colony behavior of Common Murres. Marked birds spent significantly more time on colony, switched off with foraging mates less than expected, and brought back fewer fish. Whether these short-term behavioral effects translate into larger demographic costs is unknown.

Disturbance and Predation at a Common Murre Colony, Point Reyes Headlands, California

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In 1999, we quantified disturbance by predators and competitors at five Common Murre subcolonies at Point Reyes Headlands, California. A total of 211 disturbance events (180 ground and 31 aerial) were recorded during 153.5 hours of observations. Roosting Brown Pelicans (competitor for limited space) caused only 15.2 % of the total disturbances, but half of these flushed murres. In contrast, Common Ravens (predator of eggs and chicks) caused 68.2% of the total disturbances, but only a quarter of these flushed murres. Ground disturbances were primarily caused by harassment from predators (Common Ravens, 41.7%; Western Gulls, 38.9%) and presence of competitors (Brown Pelicans, 17.2%). Aerial disturbances were primarily caused by predators (Common Ravens, 83.9%; Western Gulls, 9.7%), while disturbances caused by competitors was minimal (Brown Pelicans, 3.2%). During observations, Western Gulls scavenged 12 eggs, and Common Ravens scavenged or depredated 7 eggs and 4 chicks. Brown Pelican disturbances may have contributed to an increase in predation by Common Ravens (acting as opportunistic predators), and to the early abandonment of Cone Rock. Although disturbance events impacted productivity in recent

years, it appears as if these events had only a minimal effect in 1999.

Depth and Time Dependent Aerobic Diving Limit (ADL): Diving Metabolic Rate as a Function of Buoyancy

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Aerobic diving limit is defined as the time it takes to deplete the available oxygen stores during a dive, and has been calculated by dividing the available oxygen stores by the diving metabolic rate (DMR). Many species of avian divers have been shown to consistently surpass ADL thus defined. In contrast, a diverse body of evidence suggests that aerobic diving is predominant. In this talk it is argued that DMR is a function of buoyancy which depends on depth. Based on this, ADL is reconceptualized to be a function of depth and diving speed. This "new" ADL is calculated for two exemplary species -- Adelie Penguin and Common Murre -- showing that both species predominantly dive aerobically, in contrast to the older conceptualization. Other aspects of deep diving are also speculated.

Preaching to a New Choir: COASST and Citizen Science

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COASST (Coastal Observation And Seabird Survey Team) is a Washington-based beached bird survey program designed to couple "hard science" with "public outreach." Most COASST volunteers are regular folks, drawn from local communities and lacking field experience with birds -- so, you may ask, "Can they collect good data?" They can. We attribute their early success in beached bird identification to use of COASST's unconventional field guide -- one that minimizes jargon, promotes deductive reasoning, and displays carcasses of 50 West Coast species in living (!) color. The guide leads users through step-wise distinc-

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tions, from general to more specific characters. Volunteers start by distinguishing bird "families" by unique foot-types; a first step in narrowing the range of candidates (footless birds can still be categorized using the Wing Chord Index). Then, through a series of dichotomous choices on the applicable "Family Foot-type" page, the candidates are narrowed further. The guide then asks them to search for diagnostic species-specific traits, and provides criteria for further discrimination of sex-, age-, or season-specific plumages. Despite observers' unfamiliarity with dead birds before training, their success rate during preliminary surveys has been very high (>90% in cases confirmed by photographs or expert observers).

Supplemental Feeding of Black-legged Kittiwakes: Evidence for Early Season Food Limitation

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On average, only 65% of adult Black-legged Kittiwakes produce eggs in Alaskan colonies, and 50% of potential productivity is sacrificed in the pre-egg stage. In 1996, we began supplemental feeding studies of kittiwakes on Middleton Island, where chronic failure has resulted in an 80% decline in numbers since 1981. From 1996-1998, the evidence for early (pre-egg) versus mid-season (incubation and chick-rearing) food limitation was equivocal. In 1999, however, responses of fed and unfed groups clearly indicated a pattern of early season food shortage and relative food abundance during incubation and chick-rearing. Middleton is located near the continental shelf edge, and kittiwakes in spring rely on mesopelagic prey such as lanternfish, squid, euphausiids, and polychaetes -- a carryover of the feeding style they may employ throughout the winter. In late May or June, however, a shift in diet occurs toward near-shore forage species such as sand lance, capelin, and juvenile pollock. That

food base supports incubation and chick-rearing, whereas the deep oceanic feeding system supports adult prelaying conditioning and egg production. Variation in the timing of nest failure and responses to supplemental feeding suggest that either system can fail independently of the other in a given year.

Distribution of Marbled Murrelets in Monterey Bay, California

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Marbled Murrelets are regularly observed in northern Monterey Bay, California, yet few directed surveys have been conducted in the area. Information on winter distribution in Monterey Bay is particularly lacking. Knowledge of winter distribution of Marbled Murrelets is important for the conservation of the species. Monterey Bay is approximately 20km south of the southernmost breeding area of murrelets. Birds from this southern subpopulation probably move into the protected waters of Monterey Bay in winter months. We conducted 19 line-transect surveys in Monterey Bay between February 1999 and February 2000. Most murrelets moved into northern Monterey Bay in November, and departed in April. Direct counts of murrelets regularly exceeded 100 birds on during winter surveys. The total number of birds using northern Monterey Bay in winter may exceed 300. Most sightings throughout the year are of pairs. Creek and river plumes and tidal and rip fronts may affect the distribution of murrelets. We also summarize historic and opportunistic sightings of murrelets in Monterey Bay, and discuss specific locations of importance to the species.

Nestling Growth in Antarctic Fulmarine Petrels

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We measured nestling growth rates in Snow Petrels, *Pagodroma nivea*, Cape Petrels, *Daption capense*, Antarctic Petrels, *Thalassoica antarctica*, and Antarctic Fulmars, *Fulmarus glacialis*, during three consecutive breeding seasons. Growth rates of all four dimensions (mass, wing chord, tarsus length, and culmen length) did not vary interannually for any of the species. Absolute growth rates for all four species increased as a function of adult mass and were at least 50% higher than predicted allometrically (range=156-215% of predicted). Growth patterns, after controlling for body size, were similar for all four species despite considerable interspecific size differences. Peak mass, age at peak mass, and fledging age did not vary between seasons for any of the species. Growth constants (k) for body mass, calculated from logistic curves, ranged from 0.136 (Antarctic Fulmar) to 0.169 (Antarctic Petrel). Growth constants for all dimensions showed no consistent interspecific differences. Consistency in nestling growth across all four species and three breeding seasons, despite differences in diet composition, suggests that interannual variation in relative food availability may not regularly constrain nestling fulmarine petrel growth.

Changes in Diet of Terns and Skimmers Nesting at the Bolsa Chica Ecological Reserve in Southern California: Possible Responses to Climate Change and Shifts in Prey Populations

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The Bolsa Chica Ecological Reserve in southern California has been the nesting site of several species of tern and the Black Skimmer in recent years. We have documented changes in diet of these birds, based on dropped fish, that appear to be related in part to ocean warming and shifts in abundance and distribution of their prey. For the Elegant Tern diet, the ratio of Northern

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Anchovy to Pacific Sardine, two major prey items, declined steadily from 24.8:1 in 1993 to 0.6:1 in 1997, paralleling a decline in the cooler-water anchovy and an increase in the warmer-water sardine. However, in 1998, this tern failed to nest at the site and, in 1999, reverted to a diet marked by a 25:1 anchovy-sardine ratio. This apparent reversal in diet was not paralleled by a reversal in abundance of the anchovy and sardine, but may have been related to inshore-offshore differences in distribution of these two prey species. Caspian Tern and Black Skimmer, with more diverse diets than Elegant Tern, shifted gradually toward fewer anchovy and more sardine in their diets from 1993 to 1998.

Inland Surveys for Marbled Murrelets: Station Placement and Survey Effectiveness

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We compiled results of 3,839 inland Marbled Murrelet surveys conducted for the Washington State Department of Natural Resources between 1996 and 1999 in old-growth forests on the western Olympic Peninsula of Washington. Locations of survey sites and stations were planned to optimize among survey effectiveness (ability to detect murrelets when present) and efficiency (maximize areal coverage). Average coverage was 5.9 ha/station for 1,875 stations. This retrospective analysis examined how patterns of murrelet detections were related to characteristics of survey stations in order to evaluate effectiveness of the survey effort and possibly to refine future survey planning. We report average numbers of detections per survey visit, and used non-parametric Mann-Whitney and Kruskal-Wallis tests to estimate statistical significance. Surveys from stations within stands ($n=3,073$) had more detections (mean=1.70) than from those on stand edges (mean=0.89, $n=766$; $p<0.01$). Canopy cover did not reduce the rate of

total visual detections ($p=0.23$), and the rates of silent visual and sub-canopy detections were actually higher at high (>50%) than low canopy cover stations (mean=0.22 vs. 0.16, $p=0.03$; mean=0.15 vs. 0.10, $p=0.07$ respectively). These results suggest that current guidelines for inland surveys are effective in our environment; however, surveys in other settings (e.g., denser second-growth forests) may perform differently.

Research on Captive Pigeon Guillemots at the Alaska SeaLife Center

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Pigeon Guillemot populations in Prince William Sound have failed to recover from declines after the Exxon Valdez Oil Spill. Post-spill studies indicate that reduced availability of high-lipid, schooling forage fish and increased stress and/or physiological effects associated with continued exposure to residual oil may be limiting recovery. In 1999, eggs ($n=70$) and chicks ($n=28$) were collected from Pigeon Guillemot nests. Hatching success varied by collection site and year, apparently due to differences in egg-handling. Survival of chicks collected from the wild was higher than chicks hatched in captivity. Overall fledging success of eggs and chicks raised in captivity was 61%. Most mortality occurred during the egg stage. Chicks raised on a restricted diet of low-lipid fish (juvenile pollock) had lower growth rates than chicks raised on high-lipid fish (juvenile herring), but fledging mass and wing length were similar. Chicks raised on an ad-lib diet of herring did not grow faster than chicks on the restricted herring diet. Chicks fed two small doses of weathered Prudhoe Bay Crude Oil in food suffered no mortality and had similar growth rates to controls. Analysis of blood collected from chicks for biomarkers of oil exposure is in progress.

Wintering Razorbills, *Alca torda*, and Auk Assemblages in the Lower Bay of Fundy, Eastern Canada. Results from Two Winter Surveys 1997/98 and 1998/99.

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Wintering areas of Razorbills, *Alca torda*, in the Northwest Atlantic are poorly known. Small numbers breed at the mouth of the Bay of Fundy. Beginning in early winter, many Razorbills begin to appear off Grand Manan Island (44.7°N, 66.8°W), Eastern Canada, certainly many more than can be accounted for by local breeders. During the winter 1997/98 we conducted standardized surveys for seabirds on 26 days between November and March on which up to 53,000 auks were counted off Grand Manan. Extrapolation from the numbers of auks identified to species suggest that ca. 52,000 Razorbills may have been encountered during a transect 23 January (ca.74% of the North American population). This number dropped eight days later to 64 identified Razorbills, suggesting strong movement patterns of auks in the Gulf of Maine region. A distinct core zone of auk distribution was found around the Old Proprietor Shoals, but auk numbers fluctuated. In winter 1998/99 we did specific GPS-georeferenced surveys to collect bird samples and to investigate the extent of distribution patterns; simultaneous land-based counts from four locations were also carried out. Results are presented and discussed.

Body Mass Variation in Marbled Murrelets in British Columbia, Canada: Is it Adaptive?

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Body mass was measured in Marbled Murrelets, *Brachyramphus marmoratus*, from May - August, 1994-1998 at Desolation Sound, and Mussel Inlet during June 23-July 12, 1997, British Columbia, to assess seasonal, sexual, site and intra-annual variation, and to test whether mass was lost due to reproductive stress or to reduce the cost of flight. Birds were captured with mist-nets (all years at Desolation Sound), and by night-lighting (at Mussel Inlet and at Desolation Sound during 1997 and 1998). Birds were sexed using a molecular technique, and fecundity of females in 1997 was determined from plasma levels of egg-yolk precursors. Adult males were 203.7 ± 14.8 g, $n=495$ (juveniles 166.6 ± 28.8 g, $n=31$) and females were 201.2 ± 20.5 g, $n=344$ (juveniles 148.3 ± 23.5 g, $n=20$). Females declined in mass during the egg-laying period, but when fecund females were removed, or when the data were analyzed post-laying, no declines were found. There was no support for mass loss due to reproductive stress or to minimize the cost of flight. Marbled Murrelets are probably more income than capital breeders, and mass may be maintained at a constant (possibly near optimal) level throughout the breeding season.

Considerations of Pelagic Protected Areas

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While there is a need for Marine Protected Areas (MPAs) in the open ocean, little consideration has been given to their design and implementation because marine systems are dynamic and relatively unpredictable. We offer a review of the major issues involved in pelagic reserve design in hopes of stimulating future discussions, research, and management actions. Nearshore MPAs are often based on terrestrial models in which the physical features are fixed or predictable. In these situations, the objective is to preserve static habitats or sessile species.

Conversely, important differences arise from the unique, dynamic properties of many open ocean habitats. Here the issues of scale and predictability interact with the extreme mobility exhibited by many marine species. Thus, pelagic reserve concepts will require new designs and management approaches including dynamic reserve boundaries and large buffers around habitat hotspots. Additionally, effective conservation measures will have to scale up the preservation of isolated hotspots by protecting large-scale physical features vital for far-ranging pelagic species. We consider the following oceanographic habitats for the implementation of pelagic reserves: (1) fixed, (2) persistent, and (3) ephemeral hydrographic features.

Feeding Strategies of Peruvian, Blue-footed and Masked Boobies in Their Sympatric Distribution Area, Lobos de Tierra Island, Northern Peruvian Coast

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The feeding ecology of Peruvian (*Sula variegata*), Blue-footed (*S. nebouxii*) and Masked Boobies (*S. dactylatra*) was studied on Lobos de Tierra Island, at the northern edge of the Peruvian Upwelling System, from May 1996 to June 1998, a period when changing oceanographic conditions affected prey availability: 1996 was a cold water period and 1997-1998 was an El Niño event. The three species showed different responses to changes in the surrounding marine environment. Peruvian Boobies fed exclusively on Peruvian anchovies, *Engraulis ringens*, during 1996 and 1997. Blue-footed and Masked Boobies fed extensively on this prey during 1996, less so in 1997, and no anchovies were found in their diet in 1998. In 1997-1998, Blue-footed Boobies switched to coastal fishes other than anchovies, and Masked Boobies fed almost exclusively on oceanic prey species. Changes in regurgitate mass and mean

number of prey items in regurgitates were also observed. Results suggest that the abundance and availability of fish prey species, mainly Peruvian anchovies, determines thresholds where booby species change foraging strategies to avoid possible competition on available resources.

Parental Energy Expenditure During Brood Rearing in Black-legged Kittiwakes.

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We examined energy expenditure of Black-legged Kittiwakes raising young in Prince William Sound, Alaska. We used the doubly-labeled water method to measure field metabolic rates (FMR) of 81 chick-rearing kittiwakes at the Shoup Bay and North Icy Bay colonies in 1997 and 1998. We sought to determine if parental energy expenditure shifted spatially or temporally. Measures of FMR varied greatly among individuals (range $1.81\text{--}4.61\text{ml CO}_2\text{g}^{-1}\text{h}^{-1}$). We observed a significant interactive effect of colony and year on FMR with Shoup Bay kittiwakes showing no difference in FMR between years (mean $= 3.248\text{ml CO}_2\text{g}^{-1}\text{h}^{-1}$) and Icy Bay kittiwakes showing a significant difference in FMR between years (1997 $= 3.002$ and 1998 $= 3.420\text{ml CO}_2\text{g}^{-1}\text{h}^{-1}$). Along with FMR, kittiwake productivity in Icy Bay in 1998 was higher than in any of the other colony-by-year classes we observed. This elevated productivity appeared to be associated with a localized improvement in prey availability and we suspect this affected FMR as well. We also found a positive relationship between FMR and brood size that was not dependent upon colony or year.

Development and Ranking of Conservation Options for Marbled Murrelets on the Sunshine Coast

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The Marbled Murrelet is a provincially red-listed species in British Columbia and the population on the Sunshine Coast is considered to be the most at risk. The BC Government developed the Identified Wildlife Management Strategy in 1999 to manage nesting habitat for the Marbled Murrelet as part of its Forest Practices Code. Murrelet habitat is to be managed through the designation of large patches (>200 hectares) of suitable murrelet habitat called Wildlife Habitat Areas (WHAs). To assist with the implementation of this strategy, we developed a process to identify and rank habitat for Marbled Murrelets in the Sunshine Coast Forest District. Our objective here is to explain the current management policies, identify major concerns and demonstrate how current policy is insufficient in maintaining murrelet habitat. Major concerns include: 1) the majority of areas (58%) have less than the recommended minimum target of 10% old-growth, 2) no impact on the timber supply is allowed for murrelet WHAs, 3) WHAs can only be designated in inoperable forests which often contain poor quality murrelet habitat, 4) half of the potential WHAs identified contain approved cut-blocks.

Use of a Population Model to Assess the Effects of Feral Cats on Black-Vented Shearwaters, Natividad Island, Mexico.

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Introduced predators on islands are a leading cause of local and global avian extinctions. Seabirds are likely to be particularly vulnerable to predation because of life history characteristics including low adult mortality, low fecundity, and extended breeding period. We studied the life history and breeding biology of Black-vented Shearwaters in order to examine its vulnerabil-

ity to introduced feral cats. We report the first detailed data for this species on population size, breeding phenology, chick growth, and mortality. We estimated feral cat predation on shearwaters from an allometric equation for mammalian energetics. We created a demographic model to evaluate effects of different cat populations on the shearwater population's annual growth rate. In 1997, 76,570 pairs of Black-vented Shearwaters bred. Incubation and chick rearing lasted 51 and 69 days, respectively. We estimated shearwater annual population growth to be 1.006 without cat predation. Factoring in cat predation, we estimated that annual growth rate declines approximately 4% for every 20 cats in a population of 150,000 birds. Persistence times of bird colonies decrease dramatically both with an increase in the feral cat population and with decreasing initial bird population.

Status and Conservation of the Xantus' Murrelet in Mexico

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The Channel Islands and Pacific islands of Baja California are ecologically similar, sharing a large number of plant and animal species. Most of these islands contain important seabird breeding colonies and significant research and funding for conservation has been focused on the Channel Islands. However, the Baja California Islands have received much less attention. For example, the Xantus' Murrelet, whose primary threat is introduced mammals on breeding islands, is a California species of special concern and Mexican threatened species. While their distribution and abundance on the Channel Islands has been extensively studied, their status in Mexico is unknown. Here we report on the breeding distribution of Xantus' Murrelets in Mexico and efforts to restore their breeding islands. Xantus' Murrelets were found on nine of the 14 Mexican islands surveyed. Over the last five

years the Island Conservation and Ecology Group has removed introduced mammals on seven of 13 islands formerly or currently used by Xantus' Murrelets. Only Coronado Sur, Guadalupe, and Natividad Islands still have introduced mammals, and removal projects are underway on Natividad and Coronado Sur. Long-term planning is needed to remove introduced mammals from Guadalupe to protect the seven seabird species breeding there, including the *hypoleucus* subspecies of Xantus' Murrelet.

Barren Islands Seabird Monitoring: An Update

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To study the response of seabirds to changes in food availability and quality during the breeding season, from 1995 to 1999 we collected data annually on several breeding and foraging parameters of surface-feeding (Black-legged Kittiwake) and diving (Common Murre and Tufted Puffin) seabirds at the Barren Islands, Alaska. Breeding parameters included nesting dates, reproductive success, and chick growth rate; foraging parameters were adult nest attendance and foraging trip duration, and chick feeding frequency and meal size. During the field seasons sea surface temperature was continuously recorded. We monitored the prey base by examining chick diets and by beach seining. A related study conducted hydroacoustic and trawl surveys to obtain additional information on the food web. Preliminary results indicate that during the summer of 1999, nesting was early and productivity and chick growth were average-to-high for murres and puffins. Kittiwakes nested late and produced a low-to-average number of fledglings, although chicks grew at normal rates. The proportion of sand lance in beach seine catches was much lower than in previous years and the sea surface lacked previously typical warming intervals. The proportion of capelin in puffin bill loads has in-

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creased during this five-year project. This poster compares some preliminary results of this study.

Rissa "pelagicus": Multi-day Incubation Bouts and Foraging Trips of Breeding Red-legged Kittiwakes

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Like most seabirds, kittiwakes are monogamous with sexes sharing equally parental responsibilities of nest attendance and nestling provisioning. As a component of a larger investigation of the foraging and reproductive ecology of Red-legged Kittiwakes in the South Eastern Bering Sea, we monitored patterns of nest attendance of this species during the 1993-95 breeding seasons using tail-mounted transmitters and remote signal-logging systems. Comparable studies of nest attendance patterns of Black-legged Kittiwakes in Britain, the Gulf of Alaska, and Prince William Sound report average durations of attendance and absence (=foraging) of approx. 12 hrs during incubation (rarely exceed 24 hrs), and no greater than 4 hrs during brood rearing. In contrast, we found that Red-legged Kittiwake attendance bouts averaged 2+ days during early incubation (4- and 5-day stints were not uncommon!), 24 hrs during late incubation and the first week of brooding, and approx. 12 hrs from then until mid-brooding (approx. 20 days old). We propose that the extreme duration of Red-legged Kittiwake attendance (and foraging) bouts is adaptive because it enhances the efficiency of pelagic foraging on lipid-rich myctophid fishes by reducing the transit time between breeding sites and distant, oceanic foraging areas.

Control of Nocturnal Predators at Tern Restoration Islands

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Following removal of nesting Herring and Great Black-backed Gulls and use of social attraction techniques, endangered Roseate Terns and state-listed Common and Arctic Terns have recolonized former Maine nesting islands. However, tern restoration islands located near the mainland are frequently predated by Great Horned Owls and Black-crowned Night-herons. We attribute chronic Black-crowned Night-heron predation of most newly hatched terns at Stratton Island to a single specialist heron. Attempts to modify this behavior through "conditioned taste aversion" and other non-lethal methods either failed or proved marginally successful. Night-heron predation decreased this colony to 193 pairs by 1993, but five years after removal of the heron in 1994, the colony has increased to 1121 pairs of Common and Arctic Terns and 100 pairs of Roseate Terns. In the absence of night-heron predation, the colony now experiences sustained high productivity. Between 1993 and 1999, ten Great Horned Owls were live-trapped from Jenny Island and Pond Island NWR, Maine. Nine were banded and released over 80 km away and did not return, but one owl released just 64 km away returned to Pond Island. Control of individual predators requires intensive effort, but the approach is necessary because lone predators can undermine the success of tern restoration projects.

Foraging Effort of Breeding Pigeon Guillemots: Are High Quality Prey Harder to Catch?

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Previous studies have shown that Pigeon Guillemots achieve higher rates of reproductive success when they feed their chicks lipid-rich schooling fish instead of low-lipid demersal fish. Yet Pigeon Guillemots may feed their chicks mostly demersal fish even in situations when they apparently have access to abundant schooling fish. We hypothesized that the benefits con-

veyed to chicks by a diet rich in schooling fish may be offset to some degree by an increase in adult foraging effort that is required to capture schooling prey. For instance, the location of schooling fish may be less predictable between consecutive foraging trips than the location of demersal fish, so schooling prey might require more effort to locate and capture than demersal prey. We compared the foraging behavior of pigeon guillemots preying on schooling and demersal fish by attaching radio transmitters to breeding adults in the Gulf of Alaska and following them in boats during foraging trips. We collected data on the duration of surface and dive intervals, distance traveled from the nest, foraging site fidelity, foraging site depth, and prey capture rates.

Effects of Possible Changes in the St. Lawrence Island Polynya on a Top Benthic Predator, the Spectacled Eider

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The Spectacled Eider, a diving duck listed as threatened under the Endangered Species Act, is a principal top predator on benthos southwest of the St. Lawrence Island polynya in the Bering Sea. During winter, these birds dive to depths of 40-60 m in subfreezing water among leads in shifting pack ice, and the high costs of foraging require high intake rates at the bottom. Densities of clams are very high southwest of the polynya, because of high supply of organic matter (OM) to the benthos in a rather well-defined area. This OM may be supplied by production and brine-rejection currents in the polynya, by ice algae deposited locally by late-melting ice, or by production deposited at other times and transported to the area by brine-rejection or other currents. Sampling over several decades suggests that the benthic community has shifted from larger to smaller species of clams, along with changes in grain size and

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organic content of sediments. We here describe development of an empirically-based computer model of the foraging energetics of Spectacled Eiders, to assess effects of an altered prey base on their overwinter survival and body condition. We also explore integration of the energetics model with physical and biological models of polynya function, to examine how interdecadal weather changes might be linked to the population energetics of this threatened top predator and its prey.

Foraging Patterns of Caspian Terns in the Columbia River Estuary

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Caspian Terns breeding in the Columbia River estuary have been shown to rely upon juvenile salmonids for up to 75% of their diet. In 1999, as part of a long-term management effort, a portion of the estuary population was attracted to a former colony site at East Sand Island (River Mile 5). Using radio-telemetry, the foraging patterns of individuals breeding at this colony were compared to individuals from the Rice Island (River Mile 21) colony, where terns have nested since 1986. Tail-mounted radio-transmitters were attached to 30 terns trapped on Rice Island and 22 trapped on East Sand Island. Foraging birds were tracked from an airplane and using tracking stations at fixed locations within the estuary. During the brood-rearing period, East Sand Island terns foraged primarily in marine areas, where presumably alternative prey occurred, and Rice Island terns foraged significantly more in freshwater areas of the river, where presumably the forage base is primarily juvenile salmonids. These foraging patterns are consistent with mate and chick feeding observations at each colony, indicating 41% less salmonids in diets of terns breeding at East Sand Island.

Radar Surveys of Marbled Murrelets on the Northwest Coast of Vancouver Island

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Radar surveys of Marbled Murrelets were completed on Northwest Vancouver Island to estimate the population size and distribution in this region. 32 watersheds were surveyed with high frequency marine radar to count birds flying inland. Relationships between murrelet counts and watershed habitat features were examined using a subset of 20 watersheds. Murrelet counts were significantly and positively correlated with a number of variables describing the amount of old-growth forest occurring in these watersheds. The amount of old-growth forest at low elevation (<600m or Matlow) was the most highly correlated variable, and explained a significant proportion of the variation in dawn counts. Murrelet density was estimated as Maximum predawn radar count/hectares of low elevation old growth forest (Matlow). Murrelet density was low, ranging from 0.064 to 0.102 birds/ha Matlow forest (95% CI). Murrelet density was not correlated with the amount of remaining forest or habitat loss, suggesting that murrelets do not increase their nesting density in response to habitat loss. Radar surveys are an appropriate method for monitoring murrelet populations in much of the remote coastline of British Columbia. Additional radar surveys could increase our understanding of how nesting murrelets respond to changes in habitat availability.

Seabird Habitat Recovery Through Rat Eradication at Anacapa Island, Channel Islands National Park

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Through rat eradication Channel Islands NP and Island Conservation & Ecology Group will endeavor to restore

island populations of seabirds including Ashy Storm-Petrels, Xantus' Murrelet, Cassin's Auklet and Brown Pelican to historic numbers. Additionally it is expected that intertidal species, herpetofauna, island deer mice and various flora will respond favorably to the removal of rats. Steep topography and an endemic deer mouse subspecies (*Peromyscus maniculatus anacapae*) present special challenges for rat eradication; therefore, we propose: (1) to use aerial broadcasting as a method to distribute rodenticide bait (the anticoagulant brodifacoum at 20 ppm); (2) to apply the rodenticide during late fall when both rat and deer mouse populations are low, and to avoid nesting Brown Pelicans; (3) a trial bait drop be conducted on East Anacapa Island first. If evaluated favorably, follow up one year later with a simultaneous bait drop on West and Middle Anacapa Islands; (4) to protect native deer mouse populations by having "insurance populations" on the island(s) not being treated at the same time; (5) to monitor and document effectiveness of the eradication; (6) to initiate a program to prevent future introductions of non-native species.

Effects of El Niño Events on Cormorant Breeding Populations in the Southern California Bight

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We examined the effects of El Niño conditions in 1983, 1986, 1992-93, and 1998 on breeding populations of Brandt's (BRCO), Double-crested (DCCO), and Pelagic (PECO) cormorants in the Southern California Bight (SCB) using mainly: (1) aerial photographic surveys of breeding population size ("numbers") at several colonies throughout the SCB (1991-1998); and (2) boat and ground surveys of numbers and reproductive success ("pro-

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ductivity") at Anacapa Island (1980-1998). El Niño years were significantly correlated with reductions in numbers of BRCO and PECO at most islands. For BRCO, this correlation was greatest at islands where upwelling is typically greater. For DCCO, El Niño years were correlated with reductions in numbers at Anacapa Island and at all colonies combined only. El Niño years also were significantly correlated with reductions in productivity of DCCO and PECO at Anacapa Island. El Niño events in the 1980s and 1990s had great influence on SCB cormorant populations by leading to reduced recruitment, increased mortality, and/or colony shifting. Various anthropogenic factors (especially human disturbance) also affected cormorant populations at certain colonies.

Climate Change and the California Current

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The role of climate-ocean variation and the consequences to marine populations is not well understood. A 50yr, spatially extensive study of the California Current has shown that there have been significant interannual and interdecadal changes in the hydrography of this system. These have had major biological effects in terms of a decrease in secondary production, species range shifts and structural changes in pelagic and benthic communities. If, as we think, the frequency of the disturbances is increasing, there is cause of great concern for the status of our coastal and oceanic ecosystems. These should be carefully monitored.

Solutions to the Bycatch of Seabirds in Alaska Sablefish Longline Fisheries

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Seabird mortalities occur in longline fisheries as seabirds feed on sinking baits when the gear is deployed. All Alaska longline fisheries face closure or limitation due to the potential hooking mortality of short-tailed albatross, an internationally endangered species, and now operate under new regulations borrowed from other nations. In order to develop Alaska specific solutions to seabird bycatch, we compared seabird and fish catch rates among two seabird deterrent strategies and a control in the IFQ sablefish fishery in the Gulf of Alaska and Aleutian Islands in May and June of 1999. Deterrents were selected in collaboration with fishers and included lines with added weight to increase sink rates (0.23 kg of lead every 10 meters) and a surface deterrent, paired streamer lines (tori lines). Seabird abundance and behavior (bait attacks per minute) were also quantified during each set. General Linear Modeling (GLM) techniques were used to compare catch rates among treatments (ANOVA), and to explore linkages between catch rates, seabird presence and activity, and physical factors. Preliminary results indicate that compared to controls, paired streamer lines were more effective at reducing seabird bycatch (90%) than were weighted lines (35%).

Landscape and Seascape Patterns Associated with Marbled Murrelet Offshore Abundance

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We studied the broad-scale landscape and seascape patterns associated with offshore abundance of the Marbled Murrelet in a study area that extended from Coos Bay, Oregon to Monterey Bay, California. Old-growth forest fragmentation and marine habitat variables were measured in nine subregions of the study area. Using linear regression, we determined relationships between the habitat variables and offshore murrelet population estimates. Offshore distributions of murrelets were strongly related to the amount of

old-growth forest fragmentation inland. Murrelets were most abundant offshore of large blocks of contiguous old-growth forest within a matrix of relatively abundant mature, coniferous or hardwood second-growth forests. Marine habitat associated with more murrelets had less rocky coastline. In our model, marine habitat was relatively unimportant compared to inland habitat in determining murrelet abundance offshore.

Foraging Distances of Radio-Marked Marbled Murrelets in Southeast Alaska

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We radio marked seven female and two male Marbled Murrelets, *Brachyramphus marmoratus*, and followed their movements through the inner passages of Southeast Alaska during the breeding season in 1998. Six of the nine murrelets were detected inland in the early morning hours between 24 June and 17 July. Inland visits for each individual were consistent to a particular location, but short in duration, which precluded locating potential nest sites. We recorded 46 locations at sea up to 124 km ($x=78 \pm 27$ km) from inland sites between 19 June to 16 July. The majority of murrelets were located at sea in western Icy Strait, a productive feeding area at the mouth of Glacier Bay. This study provides the first direct evidence that murrelets in Southeast Alaska are consistently traveling considerable distances between potential nesting and foraging areas. In addition, the consistent inland attendance patterns we observed provide the first documentation that failed or post-breeding birds attend potential nesting sites. These findings have important implications for murrelet conservation

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and management efforts in Southeast Alaska.

Post-Release Survival of Common Murres, *Uria aalge*, Following the Stuyvesant Oil Spill: Preliminary Results

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In September 1999, the Stuyvesant dredge vessel spilled at least 2100 gallons of intermediate fuel oil outside Humboldt Bay, CA. Over 1200 seabirds, including 500 Common Murres, were captured alive and brought in for rehabilitation. Approximately 1 month after the spill, 31 rehabilitated and 25 control murres (all adults) were radio-marked using the subcutaneous anchor technique, and released at the mouth of Humboldt Bay to evaluate post-release survival and behavior. Rehabilitated murres had been cleaned, rehabilitated, assessed as "healthy", radio-marked, and released within 17-21 days (1 exception) while control murres were radio-marked and released within 24 hours. From October-December 1999, murres have been subsequently located by aircraft 1-2 times per week via systematic aircraft flights ranging from Monterey Bay, CA to Puget Sound, WA, and as far as 25 miles offshore. After approximately 70 days post-release, 22 of 31 (71%) rehabilitated murres and 24 of 25 (96%) control murres are presumed to have survived, already suggesting much higher survival than previous studies have claimed. Murres are presumed to be alive because no mortality signals have been detected; however, all birds are not located during each flight suggesting that murres have made extensive movements thus far and they are moving in and out of the tracking

range. Conversely, 9 of 31 rehabilitated murres and 1 of 25 control murres have been confirmed dead. Five of these carcasses have been recovered. These findings are only preliminary results and much more analyses are needed to fully interpret the ongoing data collection.

Proximal and Ultimate Factors Determining Annual and Decadal Variation in Population Dynamics of Adelie Penguins in the Ross Sea: A Demographic Model

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Population size of breeding colonies of Adelie Penguins in the Ross Sea has been tracked since 1959. These censuses demonstrate marked differences in trend between decades, as well as marked variation in size between years. We developed a demographic model to examine mechanisms responsible for such fluctuations, based on previous studies of banded Adelie Penguins breeding in the Ross Sea. We conclude that change in overwinter survival rates of adult and/or immatures (over the course of years or decades) is a necessary component explaining observed fluctuations in population size. Specifically, a population crash in the late 1980's was likely a result of poor adult survival in those years. We also examined environmental factors that may explain the observed fluctuations in population size. Extensive sea-ice in winter was correlated with reduced population growth of breeding colonies five years later, as a result of (presumed) decrease in juvenile survival. The five year time lag corresponded to that predicted by the population model. Ice extent was, in turn, related to variation in the Southern Oscillation index.

Sand Lance Habitat Modeling for Prince William Sound, Alaska

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We sought to model habitat selection by Pacific sand lance, *Ammodytes hexapterus*, by examining their distribution in relation to water depth, distance to shore, bottom slope, bottom type, distance from sand bottom, and shoreline type. We determined bottom type by re-analyzing previously collected hydroacoustic data with sediment classifying software, which was calibrated with substrate samples collected during the summers of 1998 and 1999. Through both logistic regression and classification tree analysis, we compared the characteristics of known sand lance locations to randomly selected sites. All models indicated a strong selection for shallow water by sand lance with weaker association between distribution and shoreline type, distance to shore, bottom slope, and distance to the nearest sand bottom. All sand lance locations were at depths < 60 m and 93 % occurred at depths < 40 m. We used the classification tree to determine potential sand lance habitat within the APEX study areas of Prince William Sound. We then developed a map of potential sand lance habitat and compared that coverage to independent data on sand lance locations collected by aerial observation.

Common Murre Re-Colonization at Devil's Slide Rock, California: Social Attraction Techniques and Initial Recolonization Patterns.

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In 1996, social attraction techniques (decoys, mirrors, and broadcast vocalizations) were first used to attract Common Murres to attend Devil's Slide

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Rock (DSR), California, as part of a seabird restoration program aimed at recolonization of this recently-extirpated colony (i.e., breeding had not occurred for about 10 years). Potential breeding habitat was divided into blocks and decoys were deployed at different densities in plots (located within blocks). We recorded the presence or absence of murres on DSR and within the decoy colony using a scan sampling technique. Murres were observed to use the restoration site on a daily basis and 6 pairs laid eggs resulting in 3 chicks fledging. Data were analyzed using logistic regression to model presence of murres with 4 spatial variables (block, plot, sub-plot, density) and one temporal variable (season). Block, sub-plot, density and season were significant variables in the model ($p < 0.0001$). Interpretation of the model suggests that murres were present in high and low density plots near the center of DSR. Continued and increased breeding and attendance in 1997-1999 has further supported and refined this interpretation.

When Indirect Effects Dominate: Bald Eagle Interactions with Common Murres

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Population viability of long-lived, low-fecundity animals, such as seabirds, is generally characterized by sensitivity to adult survival and relative insensitivity to reproductive output. For this reason, management and conservation efforts are often directed towards reducing adult mortality sources. On Tatoosh Island, Washington State's only known breeding colony of Common Murres experiences several sources of adult mortality including gillnet fisheries, occasional oil spills, and predation. However, population decline over the last decade is most completely explained by none of these mortality sources, but instead is a result of eagle-facilitated egg predation by

resident Glaucous-winged Gulls and Northwestern Crows. A simple demographic model shows that direct effects of eagles (i.e. predation on adult murres) only accounts for 20% of modelled population decline, whereas the addition of indirect effects (i.e. reproductive depression) accounts for the remaining 80%. This study highlights three areas of emerging conservation concern. First, indirect effects can account for a large fraction of population change. Second, colonies which were once a demographic source can turn into sinks, or even traps. Third, effective multispecies management becomes increasingly difficult when the successful restoration of high trophic level consumer, such as eagles, generate subsequent declines in their prey species.

Genetic Structure and Geographic Variation in Global Populations of the Black-Legged Kittiwake, *Rissa tridactyla*

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Black-legged Kittiwakes are small, pelagic cliff-nesting gulls with a subarctic and arctic breeding distribution. Generally, two subspecies are recognized; *R. tridactyla pollicaris*, which is confined to the North Pacific and *R. tridactyla tridactyla*, which is restricted to the north Atlantic. Studies examining plumage variation in the North Atlantic have illustrated colony specific differences in melanism. This observation in combination with the philopatric nature of this species suggests that significant genetic differences and restricted gene flow may exist among kittiwakes from different colonies. The primary objectives of this study is to determine the extent of genetic structuring and evolutionary histories of Atlantic *tridactyla* and Pacific *pollicaris* colonies using mitochondrial DNA (control region) and nuclear DNA (introns). Genetic variation was assayed by single stranded conformational polymorphism analysis (SSCPs)

and direct sequencing of haplotypes. Preliminary results from the 3' end of the control region show low haplotypic diversity of Atlantic populations suggesting that they may have experienced a series of bottlenecks in the recent past. Furthermore, we found no overlap between Atlantic and Pacific haplotypes supporting previous subspecies designations. Statistical analyses provided further evidence for genetic structuring of haplotypes within and between ocean basins and non-random segregation of sequence variation.

Sampling Marbled Murrelets at Sea: Are Two Heads Better Than One?

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Marine surveys for Marbled Murrelets are conducted using a variety of methods. Differences among methods affect population estimates and indices of productivity. To aid in the development of a standardized protocol for monitoring under the Northwest Forest Plan, we tested: (1) one observer versus two; (2) density estimates from perpendicular-distance versus radial-distance calculations; (3) variation in observer accuracy in estimating perpendicular and radial distances, and (4) the spatial distribution and detectability of adult murrelets versus juveniles, which could affect productivity indices. Across observers, the percent of murrelets missed by a single observer (20%) rather than in a team (16%) was not significantly different, but varied for individuals. Sea surface conditions and glare may influence observer performance as much as the number of observers. Direct estimates of perpendicular distance were slightly better than estimates of radial distance in most tests. Direct estimates were more precise than radial estimates, but both were biased. If observers estimate azimuths, radial estimates will have greater error. Detectability of adults and juveniles did not differ, but distribution patterns differed in some years.

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Implications for a monitoring design are discussed.

"Seabirds as Guinea Pigs" -- the Pacific Ocean Biological Survey Program and Offensive Biological Weapons Testing.

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The Pacific Ocean Biological Survey Program (POBSP) was a well-known scientific effort in the 1960s to document basic tropical seabird distribution and ecology and indigenous bird diseases in the Central and North Pacific Ocean. The program was administered by the Smithsonian Institution. Recently declassified documents indicate that the U. S. Army funded the program to locate areas where offensive biological weapons could be safely tested. In the 1964 secret project "Shady Grove", Q fever and tularemia (rabbit fever) were dispersed in aerosol tests from jets over the ocean near Johnston Atoll. On Howland and Baker Islands, project "Magic Sword" occurred, testing the efficacy of mosquitoes as disease vectors for humans. The released mosquitoes were disease-free. Feral cats appeared in 1966 after the U. S. military visited the islands; presumably cats were introduced to control the abundant mice. The cats were present until Doug Forsell et al. (USFWS) eradicated them in the late 1970s. I review the history of germs, mice, rats, crabs, cats and seabirds on these remote tropical islands.

The Use of Survival Analysis to Estimate Breeding Success and Competing Risks

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Estimates of egg and chick survival are needed in a large range of ecological and behavioral studies. There are several problems in many field studies: (1) data are often incomplete, i.e. key events such as egg laying

or fledging were missed; (2) comparisons of survival using chi square tests have low statistical power; (3) siblings lack independence; (4) often only a particular cause of mortality, e.g. predation or starvation, is of interest rather than overall mortality. Survival analysis, in particular Kaplan-Meier estimates and Cox's regression provides powerful tools to address these problems. Required data are nest checks at regular intervals, preferably daily. Thus a more laborious sampling protocol is needed than for the Mayfield method; however, the assumption of a constant mortality rate can be avoided. Examples are drawn from a study of Little Penguins in New Zealand.

A National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries

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Concerns about the incidental catch of seabirds in the world's longline fisheries led to the endorsement of the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA-S) by the Food and Agriculture Organization of the United Nations' Committee on Fisheries in February 1999. The voluntary IPOA-S applies to States with longline fisheries and would be implemented through the development of individual National Plans of Action, no later than early 2001. The U.S. NPOA-S contains the following themes: (1) regional assessments of seabird interactions with longline fisheries; (2) if a problem exists, then actions should be taken -- data collection, prescription of mitigation measures, research and development, and outreach about seabird bycatch; (3) annual regional reports on the status of NPOA-S implementation; (4) cooperative efforts between NMFS and FWS on seabird bycatch issues and research; and (5) a national commitment to advocate the development of National Plans of Action within international fora. By working cooperatively, fishermen, managers, regional

fishery management councils, scientists, and the public will use this national framework to achieve a balanced solution to the seabird bycatch problem, promoting continuing sustainability of our national marine resources.

¹SIAWG members include: Therese Conant, Kathy Cousins, Alvin Katekaru, David Kerstetter, Kim Rivera, Dean Swanson, Robin Tuttle (NMFS); Al Manville, Kent Wohl (USFWS); Stetson Tinkham (State Dept.)

Population Monitoring of Seabirds at Vandenberg Air Force Base, 1999

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In 1999 we began the first year of a long-term program to monitor the population dynamics and breeding biology of seabirds breeding at Vandenberg Air Force Base (VAFB). Because VAFB is near the southern limit of the breeding ranges for many seabird species, it is important that seabird colonies at VAFB be monitored closely and annually for many years. Changes in seabird populations tend to be more pronounced near the end of a given species' breeding range. Although population changes are largely impacted by natural factors such as food availability, disturbance by humans may also exert a major influence. At VAFB, the human activities that are potentially most threatening to seabirds are offshore oil drilling and sonic disturbances produced by rocket launches. Beginning on April 23, we identified the locations of various subpopulations of seabirds breeding from just south of Point Sal (34°53'55"N) to Rocky Point (34°33'45"N). During these surveys, we were successful in locating and estimating breeding populations of Pigeon Guillemots, Pelagic Cormorants, Brandt's Cormorants, Black Oystercatchers, and Western Gulls. We also observed Rhinoceros Auklets on various occasions, but we did not confirm their breeding activity at VAFB. We estimated a total of

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1200 seabirds breeding at VAFB in 1999.

Caspian Tern Management in the Columbia River Estuary

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The large Caspian Tern colony on Rice Island consumed about 10.8 million juvenile salmonids, or approximately 11% of the out-migrating smolts that reached the Columbia River estuary in 1998. In 1999 we attempted to relocate part of the Rice Island tern colony (river mile 21) to East Sand Island (river mile 5). After restoration of 8 acres of nesting habitat on East Sand Island, tern decoys, audio playback systems, and selective gull removal were used to encourage terns to nest on the new site. Concurrently, silt fencing was erected on 65% of the former tern colony site on Rice Island to further encourage terns to shift to East Sand Island. Despite greatly reduced colony area, close to the same number of terns nested on Rice Island in 1999 as in 1998 (about 8,000 pairs). Rice Island terns continued to consume mostly young salmon (75% of prey). About 1,400 pairs of Caspian Terns nested at the new colony site on East Sand Island, where approximately 1,600 - 1,700 chicks were raised (more than twice the nesting success of terns nesting on Rice Island). Terns nesting on East Sand Island consumed 41% fewer salmonids than terns nesting on Rice Island.

Factors Affecting the Recovery of Common Murres Nesting on the Castle/Hurricane Rock Complex

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Central California populations of Common Murres declined rapidly during the 1980's due to gill net mor-

ality, oil spills, and a severe El Niño event. While numbers have increased substantially in most areas in the 1990's, the Castle/Hurricane Colony Complex (Monterey County) has only recovered to about 52% of pre-decline numbers. Since 1997, we have observed anthropogenic and natural disturbances (i.e., murres responded by "head bobbing" or flushing) while monitoring the attendance and breeding success of these colonies as part of the Common Murre Restoration Project. Low flyovers and close approach by fishing boats occurred more frequently and resulted in increased flushing compared to observations at other near-shore murre colonies concurrently monitored in Central California. Natural disturbances caused by "space competitors" (e.g., Brandt's Cormorants, Brown Pelicans) and potential predators (e.g., Peregrine Falcons, Western Gulls) were more localized per event. The short-term and long-term consequences of these disturbances on murre population size, breeding success, or timing of breeding are difficult to measure. Any effects probably are additive to continuing mortality from gill-net mortality and oil pollution which also are affecting the recovery of these colonies.

Oceanographic Factors Influencing the Phenology and Reproductive Success of the Xantus' Murrelet on Santa Barbara Island, California

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Many studies have shown a correlation between seabird phenology and reproductive success and measures of food availability. Prior work has demonstrated a correlation between the timing of Xantus' Murrelet clutch initiation and anchovy abundance. We use monitoring data from Santa Barbara Island, oceanographic data from surrounding waters, and fisheries data from the Southern California Bight (CalCOFI program) to further investigate factors influencing Xantus' Murrelet breeding biology. We look at the

influence of anchovy abundance at different times of the pre-breeding and breeding seasons and in different areas of the Bight, as well as factors such as water temperature, upwelling indices, wind speed, and air temperature.

Colony Attendance Patterns of Radio-marked Cassin's Auklets at Triangle Island, British Columbia

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The colony attendance patterns of breeding radio-marked Cassin's Auklets were monitored during the chick rearing period in 1999. Thirty nine adults were captured and fitted with transmitters and a data collection computer (DCC II) was used to monitor the arrival and departure times of individuals over a three week period. We examined individual timing of visitation and duration of time spent at the colony to assess patterns of provisioning in relation to parental sex, chick age, and variation in weather. In general, daily attendance patterns showed that most adults arrived at the colony between 23:00 and 00:30 h and departed between 03:30 and 04:30 h. We discuss the importance of quantifying colony attendance patterns for refining methods of estimating population trends using radar monitoring.

Functional Significance of Sexual Dimorphism in Wandering Albatrosses

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Wandering Albatrosses, *Diomedea exulans*, exhibit sexual segregation of foraging zones. Males feed in sub-Antarctic waters while females forage at lower latitudes in sub-tropical zones. We investigated whether sexual size dimorphism and its effects on flight performance could explain the differences in at-sea distribution of each sex.

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mum girth, wing span, and wing area of 16 females and 20 males at a breeding colony in the Crozet Archipelago, southwestern Indian Ocean. On average, males were 20.4% heavier (9.44 ± 0.58 kg) and 7.3% larger in girth (88.0 ± 3.1 cm) than females. The wings of males were also 4.5% longer (311 ± 4 cm) and had 7.5% more area (6260 ± 265 cm²) compared to females, but aspect ratio was not significantly different between sexes. Overall, wing loading was 12% greater in males, which means they would be more constrained to foraging in areas with the strongest winds such as the sub-Antarctic regions. Furthermore, the difference in wing load combined with significant differences in body size impacts the quantity of food that each sex delivers to its chick. Consequently, sexual dimorphism has profound effects on chick provisioning strategies and the division of labor between the sexes.

Pattern of Recolonization by a Central California Common Murre Colony After Four Years of Using Social Attraction Techniques, 1996-1999

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In early 1996, social attraction equipment (i.e., decoys, mirrors, and broadcast vocalizations) was deployed at Devil's Slide Rock, California, to restore breeding at a recently extirpated colony of Common Murres. From 1996 to 1999, combined numbers of "territorial" and "breeding" sites increased from 11 to 86. "Territorial" sites (i.e., present on 15% of the observation days) often preceded "breeding" sites (i.e., where egg-laying was observed) in the following 1-2 years at the same or nearby site. In 1996, territorial and breeding sites were established in four of the twelve decoy areas. By 1999 sites were established in eleven of the decoy areas, as well as, outside of decoy areas. As a result of the change in numbers and location of sites in 1999,

formerly separated breeding murres became linked, increasing the nesting density at the colony. In this poster we examine annual growth of the colony in relation to location of sites, proximity of sites to social attractants, and proximity of sites to prior year sites.

From the Galapagos Islands to British Columbia: The Pelagic Seabird Community

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Observations of pelagic birds were collected during a seven-week, 7,800 km offshore voyage (20 April to 6 June 1999). Approximately 200 hours of seabird observations were conducted during a continuous passage from the Galapagos Islands (0°45'S, 90°W) to Bamfield, BC (48°N, 124°W). All observations were made from the deck of a 13m steel cutter, the S/V *Minke I*. Over the entire passage, we saw 972 seabirds (485 sightings), representing 34 species. The majority of sightings (75%) were lone individuals. The most abundant species were Sooty Shearwaters (n=164) and Black-footed Albatrosses (n=107). Bird abundance increased when we passed within 325km of seabird colonies or deep-sea seamounts. The species mix changed markedly at 20°N, from a booby-tropicbird-frigatebird complex to an albatross-fulmar complex. Shearwaters and storm-petrels were seen throughout the entire voyage. Few birds were observed actively feeding (2%, 10 sightings); three were associated with subsurface predators and two were observed foraging on floating plastic objects. The patterns of seabirds encountered during this passage provides new information on the distribution and habit of pelagic birds in the eastern Pacific.

Protecting Alaska's Islands from Rodent Introductions

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Rats/house mice will be introduced to additional Alaskan islands unless preventive measures are taken. The Alaska Maritime refuge has a program to deal with this threat: (1) Pribilof Islands Prevention -- harbors at St. Paul and St. George are likely paths for rodent invasion. Defenses set up in 1993 have been expanded and improved. These consist of maintaining traps and poison stations, community education, local shipwreck response capabilities, expelling infested vessels, and development of regulations. To date, several rats have been killed in preventive stations at St. Paul, and there is no evidence of rats becoming established. The local communities are taking ownership in the program. (2) Shipwreck Response -- personnel have been trained and response kits have been developed. Rodenticides are the primary tool, but their use would be limited to bait stations. Due to the ruggedness of many islands, we plan to pursue permits for aerial poison dispersal. (3) Outreach -- rodent-free ships pose no threat! Through direct contact with the shipping industry, newspaper advertisements, and distribution of free rodent prevention kits, efforts are being made to clean up vessels. These activities have centered around ships using the Pribilof Islands, and appear to be effective. This program may be expanded to other areas of coastal Alaska.

Beringian Seabird Colony Catalog

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The U.S. Fish and Wildlife Service, Anchorage, Alaska in cooperation with the Institute of Biological Problems of the North, Magadan, Russia combined seabird colony data and created the Beringian Seabird Colony Catalog (Catalog) computerized database. The Catalog stores current and historical data on breeding population size, species composition, and location

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data of 1,759 Alaskan and 453 Russian Far East seabird colonies. Forty-seven species are listed and colony sizes range from a few pair to 5.75 million birds. The Catalog consists of a relational database program linked to a geographic information system. Catalog products include computer files, data reports, and detailed maps showing colony location and sizes. The Catalog can also be accessed via the Internet. Create maps, download data, and view a video or photograph of a colony or bird species. Learn about seabird species, projects, and personnel. We welcome review of existing data and encourage observers to send new data.

Spatial Foraging Patterns of Three Penguin Species in the South Atlantic.

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We used satellite telemetry to determine foraging locations of Magellanic, Rockhopper, and Gentoo penguins nesting in close proximity on New Island in the Falkland Islands during the 1998-99 penguin breeding season. The three species showed marked differences in foraging range and location. During incubation, the two Gentoos we tracked were usually within 10 km of the colony, and were never detected more than 25 km away. The three tracked Magellanic foraged slightly farther away, generally within 25 km, but as far as 90 km. The five tracked Rockhoppers took long foraging trips, with most one-way distances exceeding 250 km. During late chick-rearing, two of the seven Rockhoppers we tracked took long trips (>340 km maximum distance from colony). The remaining Rockhoppers and the three Magellanic tracked in this period were seldom more than 20 km from the colony. All Rockhoppers that took long trips passed through a designated marine zone of potential economic development. The differences in foraging location found in this study may reflect

diet differences among these three species. The diversity of foraging locations among the species, along with inter-annual foraging location differences within species, presents a complex challenge for seabird conservation in the region.

Seabird Research in California: What We've Learned Over the Past 50 Years

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California has a long and diverse history of seabird research and conservation activities. Herein, I conduct a qualitative retrospective analysis of the accomplishments and major contributions of seabird research and conservation in California over the past 50 years. I examine important research foci by decade and address how topics of basic biology and conservation issues have changed through time. To meet this goal, I have solicited perspectives on seabird research from a variety of primary researchers in the state. The conservation issue of pollutants, both oil and chemical, has played a key role in orienting seabird studies in California during the last 30 years, but the focus of this research has become more refined in recent time. Major contributions in life history studies, foraging biology, population ecology and regulation, field methodology and statistics, and seabird oceanography will be reviewed in relation to major considerations (e.g., competition and equilibrium theory). New challenges include the effects of litigation on seabird research and the research community and ecosystem/fisheries science and conservation.

Parental Foraging Effort and Offspring Growth in Adelie Penguins: Individual Variation.

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Offspring growth rates of Adelie Penguins varied markedly among pairs at a same colony within a breeding season. To examine how parental foraging behavior affects growth rate of their chicks, we monitored diving behavior of parents, foraging trip duration, and chick mass for 17 pairs in 1996/97 at Syowa St., Antarctica. The frequency of meal delivery was positively correlated to brood growth rate. Parental foraging effort (% time spent under water) per day varied significantly among pairs (25-60 % time of a day), during chick guarding period. Individual parents tended to keep their own foraging effort levels constant. However, the foraging effort levels of individual parents could not explain the differences in offspring growth rates among pairs. The results suggest variation in offspring growth may be related to parental feeding efficiency or energy allocation to self and offspring, rather than foraging effort.

Comparison of Breeding Biology of Rhinoceros Auklets on Two Central California Islands

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In California, Rhinoceros Auklets were once plentiful, but the population disappeared for unknown reasons in the mid 1800's. A recolonization began in the 1970s, and it is estimated that three islands, Castle Rock, the Farallon Islands, and Año Nuevo Island, now provide nesting habitat for approximately 90% of the California breeding population. We investigated population dynamics, occupancy rates, and compared pairs breeding in artificial sites to those breeding in natural sites to determine reproductive performance on Año Nuevo Island and Southeast Farallon Island. We also looked at regulatory factors of population dynamics such as overall reproductive performance and survival in relation to changes in prey availability. Since 1987, Rhi-

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noceros Auklet chicks on offshore Farallon Island have been fed at least 21 different prey species, 15 of which have also been fed to chicks on near-shore Año Nuevo since 1993, however, the proportions of species differ between the two sites. We will discuss implications of documenting the changes in prey availability and selection among years has for evaluating auklet reproductive performance as well as the status of forage fish stocks in central California.

Differential Post-breeding Mortality of Adult Common Murres from Oregon Breeding Colonies in 1997-1999

Christopher W. Thompson, Thomas P. Good, Kirsten Brennan, Monique Wilson, Belen Roca, and Bernhard Krausse.* Wildlife Research Division, Washington Department of Fish and Wildlife, thompcwt@dfw.wa.gov

In June 1997, many adult murres abandoned their breeding colonies in Oregon and died on the central outer coast of Washington. Seventy-nine percent were females, differing significantly from the normal 1:1 sex ratio. Two causes may explain this: (1) both sexes die at the same rate, but females disperse before and/or at a greater rate than males from Oregon colonies, and/or (2) both sexes disperse similarly, but females die at a greater rate than males. In 1998, data from beach-cast murres collected throughout the summer on both the south and central outer Washington coast indicated that mortality rates did not differ between sexes on the south versus central coast, i.e., sex-biased mortality was not due to differential dispersal; however, female mortality decreased from 100% in mid-June to about 30% by late July. This could result from (1) inherent asymmetries in reproductive costs early versus late in the breeding season, or (2) stressors associated with El Niño in 1997 and 1998 differentially affected males versus females. Data from beach-cast murres in 1999, a non-El Niño year in which murres in Oregon reproduced well, were similar to data in

1997 and 1998, suggesting that high female and male mortality early and late in the breeding season, respectively, is due to the high cost of egg-production by females and care of fledglings by males.

Novel Sequences of Flight Feather Molt in Sooty Shearwaters and Northern Fulmars

Christopher W. Thompson, Scott A. Hatch, Mathias Leu, Kirsten Brennan, Belen Roca, and Bernhard Krausse. Wildlife Research Division, Washington Department of Fish and Wildlife, thompcwt@dfw.wa.gov

Few detailed studies have been done on flight feather molt on procelariids; most have focused solely on primary molt, and all have concluded that primaries are replaced in sequential order from the innermost (P1) to outermost (P10) primary. However, Sooty Shearwaters and Northern Fulmars both replace their primaries in a sequence that has not been described in any bird species previously: Primary molt typically begins at P2, and progresses proximally to P1 and distally to P10. Secondary molt is initiated at three nodes, first at an inner node (S20 or S21 in shearwaters, S18-S19 in fulmars) progressing proximally to the innermost secondary and distally to S16-15. Shortly after molt begins at the inner node, secondary molt begins at a middle node (S5) and progresses proximally to S14-S15. Soon after initiation at the middle node, molt begins at the third and outermost node (S1), and progresses proximally to S4. Molt of rectrices is typically highly asymmetrical and seemingly random. Shearwaters nearly always replace all of their flight feathers during molt; they also usually molt their remiges quite symmetrically, and exhibit little variation in sequence of secondary molt. In contrast, fulmars frequently fail to replace all their secondaries (or rectrices), and the sequence of secondary molt often is asymmetric and rather variable.

Breeding Chronology and Reproductive Status of the Marbled Murrelet

in Desolation Sound, BC

Laura McFarlane Tranquilla. Dept. of Biological Sciences, Simon Fraser University, lat@sfu.ca

A thorough understanding of breeding biology includes knowledge of breeding chronology of a species. Traditional methods of observation of seabirds at their colonies to understand the breeding biology are not possible for the Marbled Murrelet, which nests in old growth forests, not in colonies. Their nests are difficult to find and widely dispersed. Breeding biology of the Marbled Murrelet is currently being investigated using two nontraditional methods, including radiotelemetry and physiological analyses of plasma. An egg yolk precursor, vitellogenin (VTG), is detected in blood plasma and used to predict when the female bird is forming an egg. However, analysis of VTG cannot identify breeding males or breeding females that are no longer producing eggs. Other physiological methods to identify these birds are currently being investigated, including the analysis of the hormone prolactin in the role of parental care for both sexes. This study will use physiological methods to identify breeding individuals, and stages in the breeding chronology, such as egg-production and chick-rearing. I will test these predictions by comparing breeding status assessed from plasma analyses with breeding status determined by telemetry, for those birds which receive both treatments. This will also allow an assessment of the impact of capture and handling on reproductive success, in which all birds found to be non-breeding using radiotelemetry should also be non-breeders according to physiological analyses.

Sexual Selection, Tail Streamer Function and Demography of Red-tailed Tropicbirds at Tern Island, French Frigate Shoals, Northwestern Hawaiian Islands

Allison Veit. Department of Biology, Memorial University of Newfoundland, p99av@morgan.ucs.mun.ca

ABSTRACTS

Tropicbirds have the most elongate tail streamers displayed by any bird, and in one species, the Red-tailed Tropicbird the central tail feathers are both elongated and colored bright red, yet no study has investigated the function. Streamers formed by elongated central tail feathers are hypothesized to be the product of sexual selection because they may have no clear aerodynamic function but instead serve as ornaments displayed during the breeding season for mate attraction and intrasexual competition. I will use field experiments and observations to test whether this hypothesis could explain the evolution of tropicbird tails. My project will: (1) quantify patterns of variation of tail streamers; (2) quantify how tail streamers are used in sexual displays; and (3) use manipulation experiments to test sexual selection and aerodynamic function. The proposed work will be one of only a few studies examining the sexually selected role of an ornament displayed by both sexes. My study will be conducted March to August 2000/2001. I will also quantify local population size of breeding and non-breeding birds, productivity, and by resighting and recapturing previously marked birds quantify survival rates.

Diving in Magellanic Penguins: Comparisons and Contrasts

Brian G. Walker and P. Dee Boersma. Zoology Department, University of Washington, bwalker@u.washington.edu

Dive data collected from male (n=12) and female (n=4) Magellanic Penguins instrumented with time-depth recorders (TDRs) during two breeding seasons (1995-96 and 1996-97) at Punta Tombo, Argentina showed birds can dive to a maximum depth of 91 m (average = 72.6m) and maximum duration of 4.6 min (average = 3.2 min). Using average dive depth and dive duration of individual birds we found no significant differences in diving behavior between the two study years, but did detect diving differences within different stages of the breeding seasons

(Incubation-Early Chick-Late Chick). We also found significant differences in diving behavior between the sexes, and determined that these intersexual differences are related to body size: the largest penguins (males) dived deeper and longer, on average, than smaller (female) birds. That males can dive consistently deeper and longer than females may benefit males while searching for food, especially when prey are not abundant or when birds are in direct competition for prey resources with fisheries or other species. If a male foraging advantage exists, this may contribute to the male-biased sex ratio observed in Magellanic Penguins at Punta Tombo.

On the Evolution of Common Murre, *Uria aalge*

Kenneth I. Warheit, Vicki L. Friesen, and Tim P. Birt. Washington Department of Fish and Wildlife, warheikiw@dfw.wa.gov

We summarize data from three sources (fossils, molecules, skeletal morphometry) and propose a phylogeographic/morphological hypothesis for the evolution of Common Murre. The fossil record of murre is incomplete, but suggests that *Uria* evolved in the Pacific or Arctic Ocean at least 13-7 million years ago (mya), and moved into the Atlantic Ocean sometime later than 7-4 mya. The earliest fossil murre from the Atlantic is relatively young (12,000 ya), and may be referable to a Recent species of murre. Although *Uria* may have evolved in the Pacific, an analysis of cytochrome b sequences suggests that Common Murre evolved in the Atlantic 4.5-3 mya (estimated divergence between Common and Thick-billed Murres) and moved into the Pacific perhaps as recently as 450,000 ya (estimated divergence between Recent Atlantic and Pacific Common Murres). Analyses of control region sequences, microsatellite loci, and morphological data suggest that Common Murres in the Pacific are geographically structured, although weakly, and the pattern of this structure is complicated and locus-

dependent. Based on these data, we submit that a subspecific taxonomic revision may be necessary to more appropriately delineate evolutionary units. Finally, morphological differences in the relative size and shape of skeletal elements (in particular the wing and skull) between Common Murres in the north Pacific/Alaska and the eastern Pacific indicate that a difference in adaptive regimes may exist between these two regions.

Resting Metabolic Rate in Four Antarctic Fulmarine Petrel Species

Wesley W. Weathers, Karen Gerhart, and Peter J. Hodum. Avian Science Department, University of California Davis, wwweathers@ucdavis.edu

We measured resting metabolic rates at air temperatures between ca. -5 and 30°C in Snow Petrels, *Pagodroma nivea*, Cape Petrels, *Daption capense*, Antarctic Petrels, *Thalassocia antarctica*, and Antarctic Fulmars, *Fulmarus glacialisoides*. We measured 7 age classes for each species: adults, and nestlings that were 3, 8, 15, 28, 35, and 42 days old. Basal metabolic rate (BMR) and thermal conductance of adults averaged, respectively, 140% and 100% of values predicted allometrically for nonpasserine birds. Minimum metabolic rates of unfasted nestlings aged 15-42 days averaged, respectively, 97 and 98% of predicted adult BMR in Antarctic petrels and snow petrels versus 119% and 126% of predicted in Antarctic fulmars and cape petrels. Nestlings of the southerly breeding snow petrel and Antarctic petrel were relatively well insulated compared with nestlings of other high-latitude seabirds. Adult lower critical temperature was inversely related to body mass and differed by <2°C from that predicted allometrically. Lower critical temperature declined with age from 14 to 22°C in 3-day-old nestlings, reached a minimum at maximal nestling mass, and then increased with weight recession. Nestling lower critical temperature was close to mean air temperature from the end of brooding

ABSTRACTS

until fledgling in the three surface nesting species.

Dynamics and Modeling of Red-legged Kittiwake Populations at Buldir I., Alaska

Jeffrey C. Williams and G. Vernon Byrd. Alaska Maritime National Wildlife Refuge, Adak, AK, jeff_williams@fws.gov

Buldir I., Alaska is home to a about 6% of the world's population of Red-legged Kittiwakes. Red-legged Kittiwake numbers have doubled at Buldir from the 1970s to the 1990s in contrast to the declines in the Pribilof Islands where the majority of the world's population breeds. From 1988 to 1999, over 300 breeding adult Red-legged Kittiwakes have been individually banded and resighted. Mean over-winter survival during the period was 98% and ranged from 94-100%. Resighting probability was approximately 90%. Nest site fidelity was high and most individuals remained within 10 m of their original site during the study. We tested several survival-recapture models using program MARK and found that a time-dependent survival and recapture model best supported the data. A simple population model (see Byrd and Williams) with several assumptions was constructed to evaluate whether current population levels are sufficient to maintain population equilibrium.

Foraging Ecology and Diving Behavior of Thick-Billed Murres: Associations of Foraging Patterns, Dive Depths and Prey Selection During Chick Rearing.

Kerry Woo, Anthony J. Gaston, Silvano Benvenuti and Luigi Dall'Antonia. Department of Biology, University of Ottawa, kwoo@science.uottawa.ca

Investigation into the diving behavior and foraging ecology of Thick-billed Murres was carried out at Coats Island, Nunavut over the course of the breeding season in 1999. With the use of electronic, bird-borne depth and activity recorders we are able to quantify foraging behavior of adult breeding birds. Dive recorders were attached to the back of selected individuals with the use of cable ties and deployed for 1 to 5 days at a time. In association with dive recorder deployment, observations of individuals returning to the colony with prey items for chicks were also recorded. From these data we were able to measure the timing and duration of individual foraging trips and dive patterns. We were also able to associate foraging patterns with specific prey items. From these data we aim to relate differences in the patterns of dive behavior and diving depths of individuals with prey species delivered to the colony in relation to sex and time of day.

Should the National Park Service Allow Egg Harvesting at a Seabird Colony?

Stephani Zador and John Piatt. U.S.G.S. / University of Washington, szador@u.washington.edu

Balancing subsistence needs of Native peoples with conservation poses a challenge for resource managers in many parts of Alaska. We present a current example of the role of seabird research in developing management strategies. For the Tlingit people of southeast Alaska, South Marble Island in Glacier Bay National Park is a traditional site for harvesting seabird eggs, primarily those of Glaucous-winged Gulls. Harvesting is currently not sanctioned, but the National Park Service is considering allowing limited harvesting. The decision-making process is complicated by multiple factors and influences: (1) the gulls suffer high egg predation from bald eagles, (2) forest succession may restrict future colony size, (3) harvesting of eggs has been ongoing despite the closure, (4) harvesting contradicts the formal mission of the National Park Service, and (5) subsistence issues in Glacier Bay are politically contentious. In 1999 we began a 2-year study on the effects of egg harvesting on the gull population. The scope of this study includes modeling the effects of egg predation on hatching success, determining the physiological cost (stress response) in birds that re-lay eggs, and predicting long-term trends for the population based on historical trends. The study is designed to provide a biological basis for the management decision.

BOOK REVIEW

The Biology of Doom -- The History of Americas's Secret Germ Warfare Project. By Ed Regis. 1999. Henry Holt and Co., New York. 259 pp. ISBN: 0-8050-5764-1. \$25.00.

Reviewed by Mark J. Rauzon

President Clinton has predicted that future warfare will be biological and chemical terrorist attacks both here and abroad. If he is right, and I hope he isn't, it will be the case of "the chickens coming coming home to roost." In Ed Regis's latest book, it takes almost 200 pages before we get to the juicy parts that interest seabird biologists, but the ground covered is fascinating and relevant.

The Biology of Doom provides historic perspective and penetrating insights into the international development of biological weapons, especially the program of the United States. The U.S. Army sought to "weaponize" naturally occurring pathogens and delivery pathways to maximize human exposure to lethal and sub-lethal pathogens. This information was long held as top secret, but recent Freedom of Information Act requests and diligent research have begun to assemble pieces of the puzzle. Although some pieces will undoubtedly remain missing, Regis is piecing the jigsaw puzzle picture together.

Regis begins the historical review of biological weapon development with Japanese efforts to build a germ arsenal for use in W.W.II. Dropping vectors such as fleas and other plague-carrying insects against the Chinese is the first modern usage. (Ancient usage of biological warfare began in the year 1346, near the border of Asia and Europe. The Tartars surrounded an Italian city and catapulted their dead over the fort walls. The bodies were infected with the Bubonic plague. In two and half years, millions of people, about one

third of the European population, died from Black Death.)

The U.S. began with tests by dropping light bulbs filled with benign pathogens in New York subways, or spraying biological agents into the surf off San Francisco, and measured infiltration in the city. (This brings to mind the related LSD experiments conducted before the drug was popularized by the Merry Pranksters; in fact, the prototype Prankster was a CIA agent who spiked his colleague's drink, only to have the victim fall or jump to his death from his hotel window.)

"Extra-continental test sites" were sought for bio-weapons in the tropical Pacific, a stand-in for Vietnam. As early as 1961, President Kennedy, with Sect. Robert MacNamara approved a crash program, but needed large-scale, open air tests. These, of course, were risky, but to reduce this risk, studies had to be undertaken to determine what was in these tropical sites and what was the potential for the spread of disease. As we all know, seabird are peripatetic, and their wanderings could be a health hazard to humans (a Lesser Frigatebird ended up in Maine once), so the Pacific Ocean Biological Survey Project (POBSP) was established to determine the ranges of seabirds. Data was turned over to the Army and the tests went forward in 1964.

PSG member Roger B. Clapp is featured on page 190 as a young biologist banding Masked Boobies (his personal best was 565 in one night!) and taking blood samples which were sent to Fort Detrick, MD for analysis. (One small error is the mention of "blueberry noddies" instead of Blue-gray Noddies, but the mistake is cute and apropos.) Members of POBSP were unaware of the specifics of the Army's actions during this period, but early researcher were inoculated-just in case.

In the test Magic Sword, conducted on Baker Island, uninfected mosquitoes were released to home in on baited traps and on volunteer sailors who bared their legs. No diseases were ever released on Baker and nearby Howland Island. But the tests were done in order to determine if Venezuelan Equine Encephalitis, or VEE, could be delivered. In the 1964 test "Shady Grove", Q fever and tularemia (rabbit fever) were dispersed in aerosols by jets over the ocean near Johnston Atoll. Rhesus monkeys that were placed on barges were closely monitored to determine the LD 50 or the lethal dose that would kill 50% of the test animals. By 1966, the results were in and testing was reduced.

The offensive development program formally ceased to exist in 1969 after Nixon renounced biological warfare. (It may have begun to unravel when 3,000 sheep died from a nerve gas leak in Skull Valley, Utah.) The materials and technical information was allegedly destroyed in the aftermath. And that's why Regis's book is so important. He has salvaged the cautionary tale from scrapes of information and conversations with bio-workers now in their seventies who didn't mind getting the straight story out. Regis has given us something to think about next time the U.S. is wringing its hands that terrorists are afoot.

It's ironic that the U.S. fires missiles at Iraq and the Sudan to destroy "weapons of mass destruction" when we have (with England's help) led the world in the original R&D. (At least the Free World; the Soviets had an impressive historical program as well.). As with obsolete conventional weaponry being sold to the highest bidder abroad, America has been down his path before. It has sown the seeds of our collective demise, not with a bang but a whimper.

PUBLISHED PROCEEDINGS OF SYMPOSIA OF THE PACIFIC SEABIRD GROUP

The Pacific Seabird Group holds occasional symposia at its annual meetings. Published symposia are listed below. They are available for purchase (unless out of print). To order, see the membership application/publication order form.

SHOREBIRDS IN MARINE ENVIRONMENTS. Frank A. Pitelka (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Asilomar, California, January 1977. Published June 1979 in *Studies in Avian Biology*, Number 2. Out of print.

TROPICAL SEABIRD BIOLOGY. Ralph W. Schreiber (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Honolulu, Hawaii, December 1982. Published February 1984 in *Studies in Avian Biology*, Number 8. Out of print.

MARINE BIRDS: THEIR FEEDING ECOLOGY AND COMMERCIAL FISHERIES RELATIONSHIPS. David N. Nettleship, Gerald A. Sanger, and Paul F. Springer (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Seattle, Washington, January 1982. Published 1984 as Canadian Wildlife Service, Special Publication. Out of print.

ECOLOGY AND BEHAVIOR OF GULLS. Judith L. Hand, William E. Southern, and Kees Vermeer (Editors). Proceedings of an International Symposium of the Colonial Waterbird Society and the Pacific Seabird Group, San Francisco, California, December 1985. Published June 1987 in *Studies in Avian Biology*, Number 10. \$18.50.

AUKS AT SEA. Spencer G. Sealy (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published December 1990 in *Studies in Avian Biology*, Number 14. \$16.00.

STATUS AND CONSERVATION OF THE MARBLED MURRELET IN NORTH AMERICA. Harry C. Carter, and Michael L. Morrison (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published October 1992 in *Proceedings of the Western Foundation of Vertebrate Zoology*, Volume 5, Number 1. \$20.00.

THE STATUS, ECOLOGY, AND CONSERVATION OF MARINE BIRDS OF THE NORTH PACIFIC. Kees Vermeer, Kenneth T. Briggs, Ken H. Morgan, and Douglas Siegel-Causey (editors). Proceedings of a Symposium of the Pacific Seabird Group, Canadian Wildlife Service, and the British Columbia Ministry of Environment, Lands and Parks, Victoria, British Columbia, February 1990. Published 1993 as a Canadian Wildlife Service Special Publication, Catalog Number CW66-124-1993E. *Free of charge from:* Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3, Canada.

BIOLOGY OF MARBLED MURRELETS - INLAND AND AT SEA. S. Kim Nelson and Spencer G. Sealy (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Seattle, Washington, February 1993. Published 1995 in *Northwestern Naturalist*, Volume 76, Number 1. \$12.00.

BEHAVIOUR AND ECOLOGY OF THE SEA DUCKS. Ian Goudie, Margaret R. Peterseen and Gregory J. Robertson (editors). Proceedings of the Pacific Seabird Group Symposium, Victoria, British Columbia, 8-12 November 1995. A special publication compiled by the Canadian Wildlife Service for the Pacific Seabird Group. Published 1999 as Canadian Wildlife Service Occasional Paper number 100, catalog number CW69-1/100E. *Free of charge from:* Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3, Canada.

SEABIRD BYCATCH: TRENDS, ROADBLOCKS AND SOLUTIONS. Edward F. Melvin and Julia K. Parrish (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Semi-Ah-Moo, Washington, February 1999. To be published by University of Alaska Sea Grant, Fairbanks, Alaska. In preparation.

PUBLISHED SYMPOSIA

Information on presenting symposia: Pacific Seabird Group Symposia are initiated by one or more persons with interest in a particular topic. The goal is to present a collection of papers that explore and review the chosen topic, usually at an annual meeting of the Pacific Seabird Group. In some cases the papers are then edited and published as a Symposium of the Pacific Seabird Group. Individuals interested in organizing a symposium must first contact both the Coordinator of the Publications Committee and the Scientific Program Coordinator for an annual meeting. Important guidelines will be provided for obtaining approval, organizing, presenting, and publishing Pacific Seabird Group Symposia, including the responsibilities involved. Organizers can then proceed to put the symposium session together. This opportunity is available to all members of the Pacific Seabird Group.

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